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THE HISTORY OF AERONAUTICS IN GREAT BRITAIN

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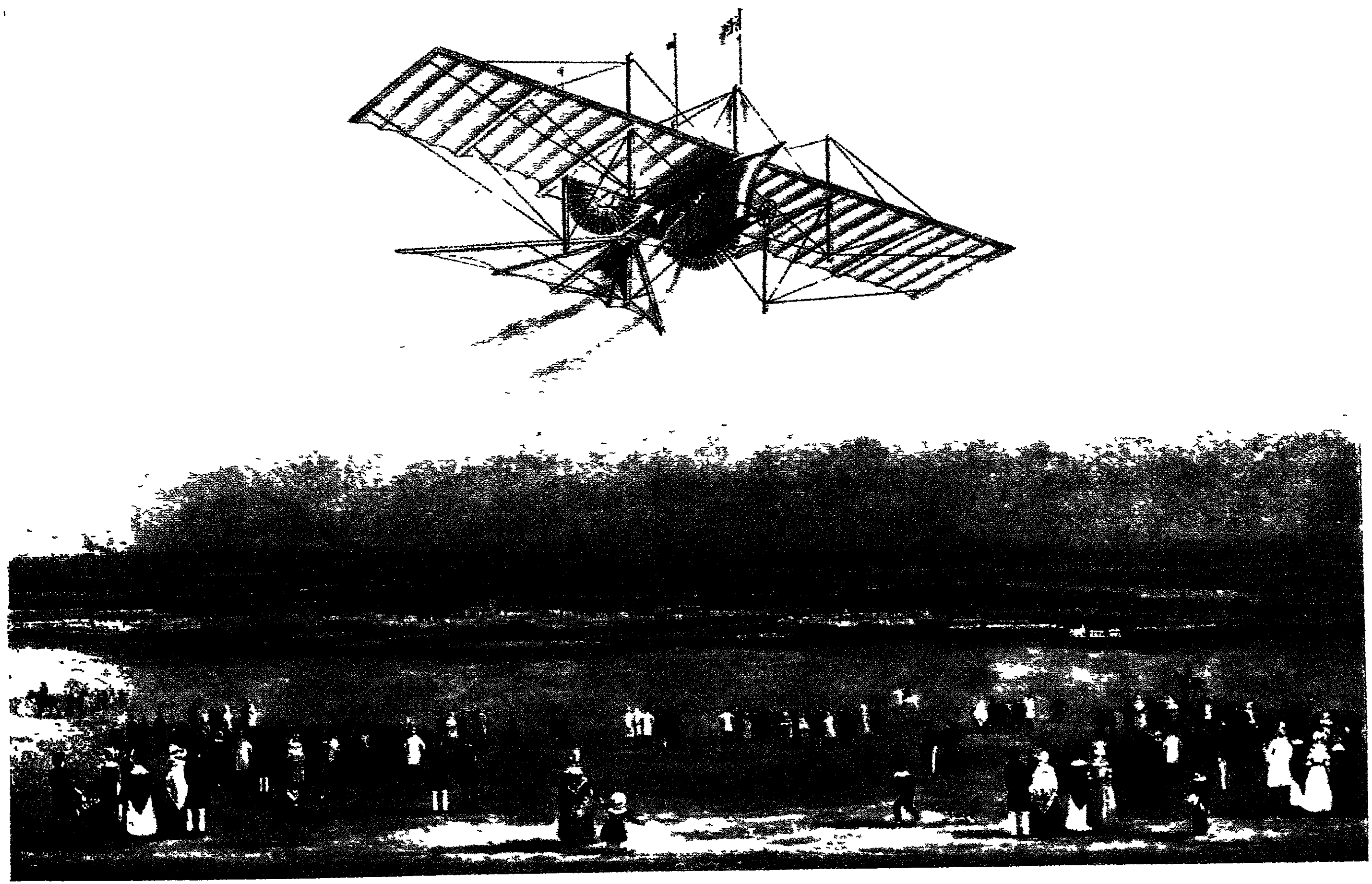

Fig 141 HENSON'S AERIAL CARRIAGE, 1843
The first design for a power-driven aeroplane

THE HISTORY OF
AERONAUTICS
IN GREAT BRITAIN

FROM THE EARLIEST TIMES TO
THE LATTER HALF OF THE
NINETEENTH CENTURY

BY

J. E. HODGSON

WITH 150 ILLUSTRATIONS FROM CONTEMPORARY SOURCES
CHRONOLOGY, BIBLIOGRAPHY, ETC.

'I am for the air . . .'
SHAKESPEARE

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BY FREDERICK HALL

To M. B.

THIS BOOK IS DEDICATED AS A TOKEN OF TRUE LOVE AND OF GRATITUDE FOR ENCOURAGEMENT AND PATIENT HELP IN THE JOINT WRITING OF IT.

PREFACE

George Borrow once wrote that prefaces are seldom read. The remark, even though it be true, does not deprive the preface of those functions it is usefully made to serve. A common purpose by way of an apology for a new book need not be employed here, for the present volume has been written in the attempt to fill a gap in the literature of British technology. For that purpose the scope of the book has been deliberately confined to Great Britain, including the endeavours of foreign aeronauts achieved within the kingdom, and it closes at a period when the complete conquest of the air, though assured, was not yet an accomplished fact. The aim has been to write a chronological narrative, paying more attention to the lives and characters of the pioneers of ballooning and flight and to the technical aspect of their work than has hitherto been done. Moreover, while striving to satisfy the requirements of a sound historical work, I have endeavoured to make the book interesting to the general reader and have kept in mind the needs of collectors of aeronautical material. To the latter—a small band of devoted enthusiasts—I trust this volume may prove useful as a work of reference, since it bears witness to the value of the activities of collectors in past times.

With regard to the limitation of scope, certain obvious and reasonable objections may be anticipated by the remark, that while there is undoubtedly a need for a sound history of international aeronautics, a considerable amount of comparative study in the aeronautical records of the world at large is indispensable before such a work can be attempted. As to the period at which the book closes, I have felt obliged to disregard the advice offered by the late Professor Walter Raleigh amongst others, to carry it down to 1903, mainly on the ground that to be of real value the extension would inevitably have involved dealing with scientific and technical matters beyond my knowledge. In any case I conceive that the historian of modern aeronautics will be obliged to

take up the threads of his subject at a point somewhat earlier than the completion of the first Zeppelin in 1900, or the flying achievements of the Wrights in 1903.

If in striving to accomplish these limited aims I have erred in burdening the pages with foot-notes, I can only suggest that the general reader should take a hint from Borrow and ignore them. They have not, however, been wantonly used in the sense aptly defined by an earlier writer on the subject, as 'bits of moorland in a park, kept to ramble in'. For though mostly referring to authorities quoted—a regrettable omission in previous books—they contain matter of interest which must otherwise have been excluded. For similar reasons compression of matter has been attained by a free use of parentheses, though the recollection of Johnson's express disapproval of that literary device, has, I trust, deterred me from unduly taxing the reader's alertness.

I gladly avail myself of this opportunity of acknowledging the help received from many quarters during the past six years. To Madame de Landa, remembered in aeronautical circles as Kathleen, Countess of Drogheda, this book is primarily due. I gratefully recall the fact that my interest in aeronautical history was inspired by the enthusiasm she evinced in January 1917, when organizing the Exhibition of Aeronautical Engravings and Paintings at the Grosvenor Gallery—an exhibition which was in a measure historic because the first of the kind held in this Country. It was in writing a few descriptive notes of exhibits loaned from the Cuthbert Collection, that I first became aware of the lack of any reliable English book of reference. Hence this endeavour to fill the gap.

To Mr. A. I. Ellis of the British Museum, Mr. E. Wyndham Hulme, formerly Librarian of the Patent Office, and to his successor Mr. A. A. Gomme, I am indebted for facilities courteously afforded and for interest of a kind that was greatly encouraging. To Mr. J. Macfarlan of the latter institution my warmest thanks are due for help and advice patiently extended over more than five years. To Lt.-Col. W. Lockwood Marsh, Secretary of the Royal Aeronautical Society, I am indebted not less for many helpful suggestions made in countless discussions on the subject, than for assistance in the reading of proofs. I am also indebted to Sir

Edward Thorpe for notes with respect to the chapter on ‘ Eighteenth Century Chemists ’ ; to Mr. Falconer Madan, for kindly assistance in the matter of that Oxford worthy, James Sadler ; to Mr. Malcolm Letts for translating Italian authorities on Zambeccari and Lunardi ; to M. Charles Dollfus for notes on the two preliminary chapters ; and to Major B. F. S. Baden-Powell and Mr. Griffith Brewer for looking through the proofs of other chapters.

In the matter of illustrations I have especially to thank my friend Mr. E. Fuld, of Amsterdam, for undertaking to supply the colour-blocks for the reproduction of his rare Lunardi bowl—a practical expression of his desire to forward the publication of this book, all the more generous by reason of its origin and because he had long before expressed the wish to be regarded as ‘ the first subscriber ’. In addition to the plates made by permission from books and engravings in the British Museum and the Patent Office, I have also to thank the Curator of the London Museum for permission to reproduce the painting of Lunardi's second balloon ; Commander Oliver Locker-Lampson, M.P., for a like courtesy in respect of his grandfather's admirable drawing of Garnerin's ascent at Lord's Cricket Ground, and Mr. C. F. Dendy Marshall for the loan of his Lunardi and Green medals.

I also greatly appreciate the assistance of numerous correspondents who have called my attention to matters pertaining to this history, or who have undertaken researches, often destined to be fruitless, in the endeavours to supply information. In this connexion it would be ungracious to omit the keenness of my fellow workers in Chancery Lane, in particular of my brother, Mr. Sidney Hodgson, who developed a faculty for ‘ spotting ’ references to ballooning and to flight in most unexpected sources.

For advice in all that pertains to the production of this book I have to thank Mr. Frederick Hall, Controller of the University Press at Oxford. It is not for me to praise the pains taken in the setting up of the type, or in the illustrations—the high standard of book-production maintained by the Oxford Press is known to all—but I have greatly appreciated his friendly interest (if I may so call it), which has made the whole business a pleasurable one. Moreover I must also express sincere thanks to the proof readers of

the Press, whose admirable care and practised skill has robbed this part of the task of half its terrors. Their work is the more deserving of frank recognition in that the credit due to them is known only to the writer.

Above all, I would gratefully record the encouragement I received from the late Air-Commodore E. M. Maitland. The story of man's struggle to obtain the mastery of the air has hitherto been, indeed still is, ignored to a large and regrettable extent. Maitland was one of the few to whom that story was of absorbing interest, as he showed by reading chapter after chapter of this book as it was written, and reiterating his conviction of the growing need for such a work. That he did not live to see it published is a source of sincere personal regret, and because I hold in high esteem his varied aeronautical career—his early enthusiasm for ballooning, his eagerness to take up flying in days when aspiring aeroplane pilots had to be their own instructors, his ardent advocacy of airships, his unobtrusive courage in demonstrating the efficiency of the parachute, and not least, his characteristic unselfishness in the final act of his life as an airman—I am sorry the book is not more worthy of his generous support. Of its shortcomings—now that it is finished and now that I begin to know something of the subject—no one can be more fully aware than myself.

J. E. H.

Bromley, 1924.

Note.—The centre ornament on the cover is reproduced by kind permission of the Council of the Royal Aeronautical Society, from the design used on the Society's Gold Medal, the first award of which was made to Wilbur and Orville Wright in 1909.

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LIST OF ILLUSTRATIONS

These illustrations are for the most part—126 out of 150—reproduced from prints and books in the Cuthbert Collection, or from additions thereto made by the writer. Generally speaking they are reduced in size, and in four cases only (Figs. 46, 60, 61, and 134) slightly enlarged. Those marked with an asterisk are reproduced in colours.

ABBREVIATIONS USED IN BIBLIOGRAPHICAL REFERENCES

(For notes on the following see Appendix III.)

Aeronaut. Soc. Rept. 1866, &c.	Aeronautical Society of Great Britain: Reports. 1866–93
Banks Collection	Banks (Miss), Collection of Broadsides (in the British Museum, press mark 1890 e. 15).
Boffito	Boffito (G.), *Il Volo in Italia.* Firenze, 1921
Brewer and Alexander	Brewer (Griffith) and P. Y. Alexander, *Aeronautics* (Abridged Aeronautical Specifications in the Patent Office, 1815–91). 1893
Bruel	Bruel (F.-L.), *Histoire aéronautique par les Monuments, Peints, &c., des Origines à 1830.* Paris, 1909
Cavallo	Cavallo (T.), *History and Practice of Aerostation.* 1785
Chanute	Chanute (O.), *Progress in Flying Machines.* Chicago [1894]
Coxwell, 1st or 2nd Ser.	Coxwell (H.), *My Life and Balloon Experiences.* First and Second Series. 1887–9
Cuthbert Collection	Cuthbert Aeronautical Collection (in the possession of the writer). See Appendix IV.
D.N.B.	*Dictionary of National Biography*, 69 vols. 1885–1912
Dupuis-Delcourt	Dupuis-Delcourt (J. B.), *Nouveau Manuel d'Aérostation.* Paris, 1850
Ency. Brit., 11th Ed.	*Encyclopaedia Britannica*, Eleventh Edition. 1911
Forster's *Annals*	Forster (T.), *Annals of Aerial and Alpine Voyages*, 1832
Glaisher	Glaisher (J.), *Travels in the Air*, Second Edition, 1871
Grand-Carteret	Grand-Carteret (J.) et Delteil (L.), *La Conquête de l'Air vue par l'Image (1495–1909).* Paris, 1910
Hatton Turnor (or *Astra Castra*)	Turnor (Hatton), *Astra Castra.* 1865
Hildebrandt	Hildebrandt (A.), *Airships Past and Present*, translated by W. H. Story. 1908
I.L.A.	Liebmann (L.) and Wahl (G.), *Katalog der Ersten Internationalen Luftschiffahrts-Ausstellung* (I L A) *zu Frankfurt am Main.* Frankfurt a. M., 1909
La Landelle	La Landelle (G. de), *Dans les Airs.* Paris, 1884
La Vaulx	La Vaulx (Comte H. de), P. Tissandier, C. Dollfus, *L'Aéronautique des Origines à 1922.* Paris, 1922
Lecornu	Lecornu (J.), *La Navigation aérienne: Histoire documentaire et anecdotique.* Paris, 1903

Lockwood Marsh	Marsh (Lt.-Col. W. Lockwood), *Aeronautical Prints and Drawings.* 1924
MacSweeny	MacSweeny (J.), *Essay on Aerial Navigation*, Second Edition. Cork, 1844
Means, 1895, &c.	*Aeronautical Annual for 1895–6–7*, edited by James Means. Boston, 1895-7
Moedebeck	Moedebeck (H. W. L.), *Pocket-Book of Aeronautics*, translated by W. M. Varley. 1907
Monck Mason	Mason (T. Monck), *Aeronautica.* 1838
Oxford Dictionary	*Oxford English Dictionary.* 1866–1923
Patent Office Collection	*Aeronautica Illustrata*, compiled by G. J. Norman, 1850–60, 10 vols., in the Patent Office Library.
Tissandier	Tissandier (G.), *Histoire des Ballons et des Aéronautes célèbres 1783–1890*, 2 vols. Paris, 1887–90
Turnor (see Hatton Turnor)	
Vivian	Vivian (E. C.), *A History of Aeronautics.* 1920

GENERAL SURVEY

PART I

EARLY IDEAS ON FLIGHT, AND THE INVENTION OF THE BALLOON

THE remarkable progress towards the conquest of the air made during the last few years lends a new interest to the story of the growth of aeronautical ideas and the attempts to put them into practice—a story which has not yet received in this country the attention it deserves. It is with the hope of arousing this attention that the main body of this work is devoted to the history of aeronautics in Great Britain and Ireland. No history of the subject, however, can be treated from a strictly national point of view. Take for example the invention of the balloon. To overlook its origin and early exploitation in France would tend to give an inaccurate idea of the circumstances which attended its subsequent introduction into England. Or take an individual pioneer in English annals, James Sadler. He deserves, and in a following chapter is accorded, his rightful place as the 'father of English aeronautics', though in the story of international aeronautics his achievements would occupy, as it were, but a line.

It is the object of this introductory survey to avert any such lack of perspective and sense of proportion, by affording the reader an outline of the essential facts in the international history of aeronautics. In the endeavour to convey a bird's-eye view—the expression is apt as applied to the history of flight, but completely fails to suggest to the imagination the range of a story covering over two thousand years—generalizations are unavoidable. If their use too frequently results—save perchance at the hands of a Gibbon or a Taine—in assertions more sweeping than a regard for precision would allow, they may nevertheless serve a useful purpose in the present instance, by making more clear than is generally realized the fact that the science of aeronautics has progressed stage by stage, as a rational though interminably slow development of ideas evolved from age to age.

The story of man's endeavours to achieve the conquest of the air may be regarded as a chapter in the history of his struggle to subdue the forces of Nature. With beginnings shrouded in the mists of prehistoric ages, that history becomes dimly apparent in the primitive conflict for mere existence, which impelled the cave-men to engage in a perpetual fight with natural forces, the more dreaded because mysterious and unknown. It is carried on even to this day in the conflict—if more confined, yet planned with deliberate intent, and still fraught with deadly consequences in the event of failure—engaged in by the scientist striving to subdue the ravages of disease, or seeking to harness the unimaginable forces of atomic energy. Not less are the latest phases of that history written in the hardships endured, if need be unto death, by the Arctic and the Antarctic explorer, the climber on the well-nigh inaccessible heights of Mount Everest, or the pilot flying (be it by airship or aeroplane), in the face of ever-present danger, to blaze an aerial trail across the vast spaces of continent and ocean. The annals of this incomparable struggle—synonymous in large measure with the progress of civilization—must ever remain of intense human interest. But the chapter which tells of the conquest of the air, strangely interesting in itself and fraught with far-reaching significance to the human race, is distinguished by characteristics unique as a record of oft-repeated failure and age-long delayed success. On earth, strong foot-gear, a trusty weapon, and a stout heart, enabled man from earliest days to roam whither he would over the face of entire continents, on warlike or trading quests. On the sea, a hollowed tree-trunk, developing into oar-propelled boats, and so to masts and sails, enabled Columbus in 1492 to discover a New World, and with it all that that great discovery signified. As age succeeded age, secret after secret was wrung from the heart of Nature, and the uttermost corners of continent and ocean were explored and charted. But the region of air continued, almost alone, to retain that inviolate sanctity to which none but the birds had access, and man remained ever defeated but invincibly determined. Coal and iron he turned to his own purposes, steam and electricity he harnessed to his own uses, and still the air maintained a resistance as completely effectual, as it was effortless, contemptuous, and enduring. With the unfolding of the tale of failure came a sterner measure of resolve, inspired by the ambition to succeed, founded on the growth of knowledge,

and strengthened by the accumulation of experience. The limited success achieved by the invention of the balloon in 1783 encouraged false hopes destined to be delayed for more than another century. But ever the goal was kept in view, and who shall say that the conception and cultivation of a great idea is less pregnant with consequence to the advancement of mankind, than its final realization and achievement ?

Four of A tical velo

It may be said at the outset that the history of aeronautics (so far as it is here related) falls into four eras, covering very unequal periods of time: first, the legendary and prehistoric era, with its tale of mythological and fabulous stories of flight, verging gradually into the historic, and extending to about the end of the fifteenth century A. D.; second, the period from the sixteenth to beyond the latter half of the eighteenth century, during which the practicability of flight was a matter of speculation and discussion, became the subject of imaginative romance, and was made the object of theoretical projects and not a few practical attempts; third, a shorter period dating from 1783, which saw the first limited measure of success in aerial navigation as witnessed in the discovery, exploitation, and ultimate discredit, of the 'free balloon'; and fourth, the period of the nineteenth century, which gave birth to countless endeavours to render the balloon as navigable in air as the ship at sea, and—in view of the apparent failure to do so—renewed attempts to achieve human flight by mechanical means.

These four periods, though adequate for the present purpose, might be enlarged and extended as in the following attempt to tabulate, by means of generalized headings, the main periods in the evolution of aeronautics :

Period.	*Date.*	*Example.*
Mythological and Legendary	Pre-historic	Daedalus and Icarus (Greek Mythology); Bladud, the Flying King of Britain, 850 B. C.
Beginnings :		
1. Aspiration	Prior to the 15th century	The Psalmist (Saec. vii B C.)
2. Speculation		Roger Bacon, *ca.* A. D. 1250.
3. Endeavour		Oliver of Malmesbury, *ca.* A. D. 1040.
Growth of Ideas :		
1. Winged Flight		
a. Mechanical Devices	16th to the 18th centuries	Leonardo da Vinci, 1505.
b. Physical Objections		G. A. Borelli, 1680.
2. Lighter-than-Air		Lana-Terzi, 1670.
3. Romance		Bishop Godwin, 1638.

Period.	*Date.*	*Example.*
Limited Achievement:		
1. Invention of the Balloon (Aerostation)	1783 onwards	Montgolfier (Hot Air) and Charles (Hydrogen), 1783.
2. Attempts to Navigate Balloons		Meusnier, 1784; Pauly and Egg, 1816.
3. The Parachute		Garnerin, 1797.
Development of Aeronautical Science:		
1. Bird Flight and the Aeroplane (Aviation)	1800 to 1870	Cayley, 1810; Stringfellow, 1848; Wenham, 1866.
2. Airships		Cayley, 1816; Giffard, 1852.
Aerial Navigation:		
1. Motor-driven Airships		
a. Non-rigid	1870 to 1903	Renard and Krebs, 1884.
b. Rigid		Count Zeppelin, 1900.
2. Gliding Experiments		Lilienthal, 1891; Pilcher, 1895.
3. Motor-driven Aeroplanes		Wright Brothers, 1903.

tion Incidentally, as arising out of this delimitation of periods,
sta- two essentially different methods of achieving flight were revealed as the centuries passed—the so-called 'heavier-than-air' method, or aviation, and the 'lighter-than-air', or aerostation. For while man's earliest notions—destined to be fostered but foiled through many centuries—were based on the obvious analogy of winged flight observed as a phenomenon of Nature, the first ascent into and passage through the air was actually accomplished towards the close of the eighteenth century by a method up to that time almost wholly unlooked for, namely the invention of the balloon. That invention gave rise to hopes the early fulfilment of which was impossible, with the inevitable result that the balloon—and to some extent the important aerostatic principle involved therein—fell into general disrepute. On the other hand, the pioneers of mechanical flight (mainly winged flight, to be achieved by human agency or the application of power) continued to pursue their aims with as little measure or prospect of immediate success. Ultimately this period of static endeavour—in which the navigable balloon moved a little nearer to practical achievement—gave rise during the latter half of the nineteenth century to two rival and widely different schools of thought, both waiting the advent of a prime mover—in the form, as it proved, of the internal combustion engine—in order to achieve their hitherto unattainable end. That end, aerial flight or navigation through the air, was in fact a common aim, and—as Cayley pointed out with bold foresight in 1809—the two methods of achieving it were not antagonistic, though to this day the respective capacities of the airship and the aeroplane have not been finally resolved.

The Antiquity of the Idea of Flight.

Of the great antiquity of the idea of flight as an inspiration and a desire amongst widely scattered races of men there can be no doubt. The cry of the Hebrew psalmist, 'O that I had wings like a dove; for then would I fly away and be at rest,' expressed for all nations and for all time, in the metaphorical sense of flight, the desire to soar into ethereal regions above all earthly troubles.[1] The mythologies and legends of Greece and Rome, as also of Scandinavia and the East, by their very nature gave rise to countless fables of winged flight. Of all these the story of Daedalus and Icarus—which has its counterpart in the Scandinavian legend of Wayland, the smith who forged wings—is not only the most generally quoted, but in so far as it related to the making of wings by Daedalus, and the human adaptation of them for the purposes of flight (in an escape from imprisonment), is typical of human endeavour for centuries to come. Of equal if not greater significance, though certainly less well known, is the earliest story of the kind in British legendary history, that of Bladud, the Flying King of Britain, in the ninth century. For here (at least in those versions of the story to be found in the later chroniclers) the supernatual element is absent, and gives place to the purely human motive expressed in the desire to perform a wondrous feat.

Flight in the Middle Ages.

The transition from the idea of flight embodied in mythology as a supernatural attribute of the gods, to the spectral flittings of sorcerers and magicians preserved in folk-lore and legend, and thence to the historic records of flight attempted as a means of aerial locomotion, was inevitably a matter of centuries. The intellectual atmosphere and the ignorance of the Dark Ages tended to preserve the attitude which regarded flight as the accomplishment of devils, witches, and other forces of evil. The apocryphal account of the flight of the sorcerer Simon Magus, who, overcome by the prayers of St. Peter, fell to the ground, may stand to typify the association of flying with necromantic art.[2] Perhaps it may also serve to suggest the grounds of the ecclesiastical disapproval of any idea of human flight, which persisted down to the fifteenth century. It is true that the argument used by Eusebius two centuries later was based on the unwisdom of attempting to break the laws of Nature and the

[1] It has been pointed out that the bird cited in verse 6 is the wild rock-dove, capable of fast and sustained flight.

[2] Smith (Sir W.), *Bible Dictionary*, vol. 3, 1893, p. 1821.

decrees of Providence, rather than on theological or immoral grounds. But a modified statement of the older attitude is found as late as 1753, when Clemente Baroni put forward the thesis that the atmosphere has always been and will ever remain a region unknown to man, and that not even the 'Demon' himself has the power to reveal any artifice which would enable man to explore the aerial regions.[1] At a still later date such arguments dwindled down to the contention (as William Cowper put it in 1783) that had man been intended to fly God would have provided him with wings.

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Nevertheless the stories of flight extant from the first twelve or fifteen centuries of the Christian era bear witness to a changing attitude. Such is the anecdote of the would-be Daedalus, killed in an attempt to fly during the Roman games held before Nero (A. D. 57)—an event which Suetonius briefly relates as a merely spectacular incident. Moreover, in narrating the story of Oliver of Malmesbury's youthful exploit (about A. D. 1040), the early chroniclers record the event without theological bias, and it is rather the folly than the wickedness of these endeavours that excited comment. Indeed such other flying feats as are recorded—for instance, the fatal flight of the Saracen in the hippodrome at Constantinople during the eleventh century (recorded by Curione),[2] or the winged flight of John Damian, the adventurous Abbot of Tungland, who in 1570 sought to fly to France from the top of Stirling Castle—are of interest mainly as evidence of the perennial desire to achieve flight, existent in the minds of men in early times, and strong enough to overcome the risk of life and limb involved in so daring and dangerous an enterprise.

'Flying on' of ıytas, B.C., escribed Aulus ius (2nd ury .)

Beyond the fact that wings of some sort were used by these remote pioneer experimentalists, nothing is known of the nature of the mechanism—if indeed it can be so called—by means of which they made attempts. As a matter of fact the mechanical aspects of the earliest known and much less ambitious aeronautical project, namely the 'flying pigeon' of Archytas of Tarentum, in the fifth century B. C., excited far more discussion amongst the learned during the next two thousand years than did the futile exploits of would-be 'flying men'. Possibly this is due to the account of it in that 'entertaining book of anecdotes', the *Attic Nights* of Aulus Gellius, written during the second century A. D., and

[1] Baroni (C.), *L'Impotenza del Demonio di trasportare per l'aere*, &c., Rovereto, 1753.

[2] Curione (C. A.), *Saracenica Historia*, 1596, p. 63. The story is also related by Cousin (L.), *Histoire de Constantinople*, 8 vols., 1672.

first printed in 1469. According to Wilkins, Gellius thought that the flight of the pigeon of Archytas was contrived by 'some lamp, or other fire within it, which might produce such a forcible rarefaction' as to impart movement, while Jerome Cardan (1501–76), though he doubted the possibility of such contrivances, nevertheless admitted that if such an automaton 'be a little helped in the first rising, and if there be any wind to assist it in the flight, then there is nothing to hinder, but that such motions may be possible'.[1] On the other hand, J. C. Scaliger (1484–1558), one of the most learned men of his day, conceived the making of 'volant automata' to be very easy, and in connexion therewith he offered the suggestion—an interesting one in the light of modern airship practice—that gold-beater's skin would be suitable for the purpose. Athanasius Kircher, in his *Ars magna lucis et umbrae*, 1671, as well as other scientists of the sixteenth and seventeenth centuries, likewise discussed 'volant automata' of various kinds, though these writings have little direct bearing on the evolution of human flight.

and discussed by Cardan, Scaliger, and others in the 16th and 17th centuries.

The first dawn of a rational idea of flight and of a belief in the possibility of achieving it, was revealed in the writings of Roger Bacon. Bacon's ideas have been the subject of oft-repeated misrepresentation and false enlargement, and it is sufficient to note that they were in the direction of an 'engine' with wings, designed to fly after the manner of a bird. But a long period of darkness—to strain the metaphor—was destined to obscure these first scant and simple notions, though doubtless the exploit towards the end of the fifteenth century of Giovanni Battista Danti, a mathematician of Perugia, who is said to have attempted winged flights over the lake of Trasimeno in Umbria, may be cited as evidence of primitive endeavours of a practical kind.[2] It was not, however, until nearly two hundred years after Roger Bacon that a greater and more universal genius, Leonardo da Vinci, applied his mind to the problem of flight on scientific and mechanical lines. Leonardo's extraordinarily interesting designs for winged flying apparatus and helicopters, and his notes thereon, as well as a series of acute observations on the flight of birds, are to be

Speculations of Roger Bacon (1214–94).

Alleged Flights of G. B. Danti (*ca.* 1490).

Leonardo da Vinci (1452–1519). His Notes on Bird Flight and Flying Machines.

[1] Wilkins (J.), *Mathematical Magick*, ch. vi. Rozier (pp. 163–75) gives the Latin text, with French translation, of the passages in which Gellius, Cardan, Scaliger, and others discussed flying automata. Cf. Bourgeois (D.), *Recherches sur l'art de voler*, 1784. Faujas de St. Fond (vol. i, p. xxx) quotes Scaliger's reference to gold-beater's skin.

[2] Boffito, cap. 5, where the matter is fully discussed, and the seventeenth-century authorities quoted.

found in the famous collection of his manuscripts, the so-called 'Codex Atlanticus', and in the notebook known as the 'Codice sul Volo degli Uccelli', written in 1505. These remarkable ideas, described in the oldest manuscripts and sketches extant on the subject of flight, including (it should be added) a brief exposition of the principle of the parachute, were hidden for nearly three hundred years in the obscurity which overtook Leonardo's manuscripts. Indeed, save for a passing reference by Pierre Boaistuau, otherwise Launay, in *Le Théâtre du Monde*, 1558, to the effect that Leonardo 'sought out the Art of Flying' and nearly achieved his end,[1] and the more brief and disparaging statement of Cardan in 1580—'Vincius tentavit (volare) sed frustra: hic pictor fuit egregius'—the sketches and notes of the great artist and mechanician lay unnoticed until their existence was revealed to scholars by J. B. Venturi in 1797. Even now, though a considerable part of Leonardo's manuscripts have been reproduced in facsimile, neither the notes nor the sketches bearing on flight have yet been adequately interpreted or discussed.[2] An exception must, however, be made in respect of Leonardo's diminutive sketch of a 'parachute' and his note on the principles it involved, inasmuch as this idea was elaborated by Fausto Veranzio in his work, *Machinae Novae*, published at Venice about 1595, wherein the plate entitled 'Homo Volans' depicts a man in the act of using a square of canvas as a 'fall-breaker' in a descent from a high tower.

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With the extended intellectual outlook which followed the era of the Renaissance, slowly but steadily the idea of flying gained a place in men's minds, as the period of the seventeenth century witnessed. Francis Bacon, in the words of the sage in the *New Atlantis*—'We imitate also flights of birds'—aptly phrased the conception which continued to be generally retained up to the later years of the century following, and after. The scientific observations on flight made by Bacon in *Sylva Sylvarum* are not specially notable, but it is in a minor degree significant that the words quoted are used in an imaginative sense—an aspect which (somewhere about 1590) had engaged Bishop Godwin in his romance of *The Man in the Moone*. For doubtless at this period scientific speculations on flight must

ht as a ıect of ıance ıe 17th ury,

[1] The words quoted are from a translation of 1679 See Bibliography, p. 398.

[2] Since writing the above, Leonardo's writings on flight have been carefully analysed by Ivor B. Hart in two admirable papers published in the *Journal of the Royal Aeronaut. Soc.*, vol. xxvii, 1923. See also Boffito, cap. 4.

have seemed closely akin to romance, and the reference by the great astronomer Kepler to the founding of colonies in the moon; the reflections on flying indulged in by Bishop Wilkins in his scientific treatise, *Mathematical Magick*, 1648; the later prediction of Joseph Glanvill—to his contemporaries a man learned in the world of natural philosophy—that to future ages it might become 'as ordinary to buy a pair of wings to fly into remotest regions', as it then was to buy a pair of boots, or the discussions on flight in Fontenelle's *La Pluralité des Mondes*, 1686, were deemed wholly extravagant and visionary. Godwin's romance—first printed in 1638, and a lineal descendant from Lucian in that kind of writing—gave expression with admirable spirit, and for the first time, to the idea that the honour of being the first man to fly would be comparable with that achieved by the daring sailor, as immortalized by Horace, who 'first adventured to sayle upon the Sea'.

Thereafter the literatures of England, France, and Italy afford many examples of flight imaginatively treated, not infrequently in connexion with journeys to the moon. Cyrano de Bergerac (1620–55), following the fanciful example of Godwin, used his fantastic imagination in the *Histoire Comique de la Lune et du Soleil*, 1657–62, to relate aerial journeys to the lunar and solar worlds, wherein flight is achieved by such chimerical inventions as the ascensive powers of dew when contained in glass balls and subjected to the sun's rays, or the use of a 'very light machine of iron' drawn upwards through the atmosphere by the attractive power of the load-stone.[1]

In the eighteenth century flight as a subject for the imagination was revived by Dr. Johnson, who toyed with it in *Rasselas*, while it is an essential feature of the flying romance of Robert Paltock—who cast back to Bishop Wilkins for the name of his hero—as also of Restif de la Bretonne's *Découverte australe par un Homme-Volant*, 1781, in all of which it is notable that the aerial adventures are confined to this earth. Even nearer in its approximation to modern achievement was the imaginative poem (in the form of a eulogistic amplification of Lana's 'flying boat'), descriptive of a voyage in an 'air-ship' to Peru and Canada, inspired by Lana's project, written by Bernardo Zamagna, and published in Rome in 1768.[2] But clearly such 'romancing' is of no significance in aeronautical history,

and the 18th century.

[1] Cyrano's entertaining romances have recently been translated anew by R. Aldington [1923].

[2] See Boffito, p. 145.

except in so far as it must have served to familiarize and to strengthen the idea of aerial flight as a desirable human achievement.

Science and Flight in the 17th century.

Reverting to more serious speculations in the seventeenth century, it can hardly be doubted that the writings of Bishop Wilkins were amongst the earliest printed works in which the 'Art of Flying' was theoretically considered as a scientific problem. Nor is it less certain (as Professor Raleigh has suggested) that these novel ideas, emanating from a scholar widely versed in natural philosophy and science, 'made a deep impression on his own age'.

Bishop Wilkins (1614–72): his Ideas on Aerial Flight.

Though Friedrich Hermann Flayder had suggested in his *De Arte Volandi*, published at Tübingen in 1627, that men ought to be able to fly with wings as easily as a bird, his treatise is in the main confined to vague and general conclusions. Wilkins himself did not pretend to do more than propose the theory of flight, but in pointing out the difficulties he insisted that these could only be overcome by careful inquiry and frequent experiments. His ideas and speculations were first elaborated in 1640, as a *Discourse concerning the possibility of a passage to the World in the Moon*, appended to the third edition of his *Discovery of a New World*, and the author enlarged them somewhat, eight years later, in his *Mathematical Magick*. Broadly speaking Wilkins dealt with winged flight after the manner of birds, and realizing in connexion therewith the inadequate strength of a man's arms, he suggested (as did Willughby in his great contemporary ornithological work, and as indeed Leonardo had done more than a century before) that it might be possible to use both legs and arms. But his ideas went beyond the mere conception of human flight, and in discussing the possibility of making a 'flying chariot', he raised questions as to the relative length and breadth of the wings, the weight and necessary strength thereof, as well as the need of control, and he even ventured so far as to suggest the use of mechanical motive power.

Robert Hooke (1635–1703): Experiments in Aeronautics.

In England Wilkins was followed by his friend Robert Hooke, a man of wider scientific attainments and withal a remarkable mechanician. As early as 1655 Hooke made experiments on the 'art of flying in the air' contrived on model scale 'by the help of springs and wings', but though his researches continued for some years they were apparently fruitless and no detailed record of them is extant. Indeed, his only printed contributions to aeronautical science are to be found in the *Philosophical Collections*, 1679, in which he transcribed an account of the alleged flying

achievements of Besnier, and gave a translation of the sixth chapter in the *Prodromo* (wherein Lana describes his famous aerostatic project), in both cases adding comments of his own. Hooke's comments on Besnier are interesting if only because they reveal the fact that there had been in his time several attempts at winged flight, though nothing is known as to the contrivances used. Allard, a French tight-rope dancer, endeavoured about 1660 to fly—or more probably to glide with the help of inclined planes—before Louis XIV at St. Germain, but his attempt failed. The experiments of Besnier, a locksmith from Sablé, were made in 1678, his novel apparatus consisting of four hinged flaps, or wings, fixed to two horizontal rods, and worked over the shoulders by both hands and legs. As with all previous and innumerable later devices, it proved to be completely ineffectual.

Borelli's Physical Arguments against Flight, 1680.

If the cumulative effect of these repeated failures to achieve flight were greatly discouraging, it is even more probable that the dissemination of the view expressed by Borelli in his learned work, *De Motu Animalium*, must have seemed to render all hopes utterly futile—in that author's own words, 'the Icarian invention is entirely mythical because impossible '.[1] Though Borelli's explanations of bird flight are vitiated by the errors common in his day, particularly in the importance attached to the downward flap of the wings, his conclusions (based for the most part on careful observations on the habits and movements of birds) afforded a reasoned refutation of the practicability of winged flight by man, owing to wholly insufficient strength in the pectoral muscles. Borelli's dogmatic statement, supported by the greater scientific authority of Leibnitz, carried widespread assent. It encouraged the sceptical attitude typified in England by Sir William Temple's scornful references to ' airy speculations ' and ' the art of flying till a man happens to fall down and break his neck ', or Addison's more gentle but not less effective satire on the projects of modern Daedalists—an attitude of incredulity and ridicule which not only marked the close of the seventeenth century, but which flourished throughout the eighteenth, and cannot be said to have wholly died out until the early years of the twentieth century. It is in any case the fact that both in England, France, and Italy—the three countries from which the most fruitful contributions emanated—the eighteenth

Incredulity thereby confirmed.

[1] Borelli (G. A.), *De Motu Animalium*, Roma, 1680–1, Prop. 204, ' Est impossibile ut homines propriis viribus artificiose volare possint '.

century was marked by a dearth of ideas on the art, or science, of mechanical flight.

The Aerostatic Principle.

On the other hand the realization of the impossibility of flying with wings tended to divert attention to the only other conceivable way of achieving aerial navigation, namely the 'lighter-than-air' method as projected by Lana. The principle of that method, as laid down in the law of Archimedes governing the flotation of bodies in liquids or gases, was of course known to the scientists of the sixteenth and seventeenth centuries. Simon Stevin, a distinguished mathematician of Bruges, made notable additions to such knowledge about the middle of the sixteenth century. Albertus Magnus in the thirteenth century referred to the subject in his exposition of Aristotle, and in the century following Albert of Saxony maintained that upon this static principle the air was navigable to some extent. In the seventeenth century these ideas were revived and discussed anew by Francisco di Mendoza and Gaspard Schott. Schott, a Jesuit who earned a high reputation by his works on the physical sciences, went farther than Mendoza in asserting his belief that bodies of greater specific gravity than air might yet be made to float therein, just as hollow bodies of wood or iron will float in the water if filled with air. In like manner Wilkins—who also referred back to Archimedes and Mendoza—suggested that such speculations afforded grounds for the belief that it might be 'possible to raise a new Science, concerning the extension of Bodies in comparison with air'. These discussions, with others arising out of the speculations of Laureto Lauro, a Jesuit of Spoleto (whose quaint notions were quoted by Schott), and of Athanasius Kircher, also a Jesuit, and a man of extraordinary erudition in the sciences of his time, when regarded in conjunction with the physical discoveries of the same period—notably the barometer by Torricelli in 1643 and the air-pump by Otto von Guericke in 1650—lead almost naturally to the first definite project of an aerostatic character.

The Archimedean Law (250 B. C.). Speculations of Albertus Magnus (1193–1280), Albert of Saxony (Saec.XIV), G. Schott (1608–66), Laureto Lauro (1610–58), and Athanasius Kircher (1602–80).

Lana's 'Flying-Boat', 1670.

This was the well-known 'flying boat' of the Jesuit priest Francesco de Lana-Terzi (to use his family's full patronymic), his idea being to lift a boat-shaped car into the air by means of the ascensive power of four large globes of very thin copper, from which the air had been wholly extracted, and which, weighing (as Lana calculated) less than the surrounding air they displaced, would therefore float in it. The scheme, as described in Lana's compre-

hensive scientific treatise, the *Prodromo*, 1670, aroused widespread discussion amongst the learned. Incidentally it inspired in the country of its inception, during the next hundred years and more, poetic effusions of a eulogistic or descriptive character, which must have increased the vogue of Lana's idea. J. C. Sturm, who played a considerable part in reviving in Germany the study of the physical sciences, published an explanation of Lana's idea in the *Collegium Experimentale*, 1676, with a Latin translation from the *Prodromo*. Philipp Lohmeier, a professor of physics at Rinteln, followed with a defence of the project in his treatise entitled *De Artificio Navigandi per Aërem*, 1676, though he suggested the use of six or eight globes instead of four. But the impossibility of making globes of sufficient size and lightness, combined with strength to withstand atmospheric pressure, was conclusively demonstrated by Hooke, Borelli, Leibnitz, and others, and the 'flying boat' survived merely as an original but impracticable notion of aerial navigation on the aerostatic principle.

The Project defended by J. C. Sturm (1635–1703) and P. Lohmeier,

but criticized as impracticable by Hooke, &c.

Nevertheless, the idea of constructing a vessel to float or sail in the air was not abandoned. Whether the 'flying boat' alleged to have been invented at Lisbon in 1709 by a Brazilian priest, Bartholomeu Lourenço de Gusmão (1685–1724), was of that character, has not been certainly determined—indeed, the whole matter is one of doubt and controversy.[1] Gusmão's 'Passarola' —the suggestion of swallow-like flight cannot have been sustained otherwise than in the name—apparently combined in the body of the machine the use of wings (or feathers), the attractive power of magnets, and possibly the levity of rarified air, while above the whole was a sail presumably designed to act somewhat in the nature of a parachute. The project is well known from the contemporary engravings, but beyond the fact that the inventor imposed his invention on the credulity of the King of Portugal with pecuniary success, there is little authority for regarding it seriously.

Gusmão's 'Passarola', 1709.

About fifty years later the speculations of Joseph Galien (1699–1762), a Dominican professor of philosophy and (in the opinion of Dupuis-Delcourt) a man of great wisdom and learning, were definitely conceived on 'lighter-than-air' principles. Galien explained his ideas in a small volume published at Avignon in

J. Galien's 'Lighter-than-air' Project, 1755.

[1] See Tissandier, vol. i, p. xix, and Bruel, no. 14. For defences of Gusmão's project cf. Simoes (A. F.), *A invenção dos aerostatos reivindicada*, Evora, 1868 ; Faria (Vicomte de), *Lourenço de Gusmão (1685–1724), inventeur des Aérostats*, Lausanne, 1911 ; and Neves (G. T.), *As Esperiencias Aerostaticas de B. Lourenço de Gusmão*, Lisbon, 1911.

1755 and entitled *L'Art de Naviger dans les Airs*, the first part of which is a treatise on the nature of hail.[1] On the assumption that the air at high elevations is lighter than the circumambient air, he proposed the construction of a vast machine (of dimensions greater than his native town of Avignon) which he suggested would be capable of transporting a large army to the middle of Africa. But he gave no explanation how he proposed to inflate this veritable Noah's ark—the comparison is Galien's own—with the rarified air from 'la région de la grêle', an omission which emphasizes the chimerical character of his imaginative notions, though his scheme is of interest, nevertheless, as again predicting the principle of the balloon.

Cavendish's Discovery of the Weight of Hydrogen, 1766.

Its significance was enhanced less than ten years later, when the important announcement of the specific gravity of 'inflammable air' (or hydrogen, as it was subsequently termed by Lavoisier) made in 1766 by Henry Cavendish, was destined to afford a method of inflating a globular vessel with gas lighter than the unprocurable rarified air which Galien suggested—a gas, moreover, of which sufficient quantities could be obtained by chemical processes. But though Cavendish's discovery—the outcome of important investigations into the nature of air and gases carried out during the previous hundred years by Boyle, Stahl, Black, Lavoisier, and others—at once made the 'lighter-than-air' method possible; though Black promptly suggested that a bladder so inflated would rise in the air, and though Tiberius Cavallo experimented during 1781 on these lines—without success, save that in blowing soap-bubbles with hydrogen he was the first to witness on a miniature scale the phenomenon of the balloon—the invention of the science of aerostation was delayed for over fifteen years. That invention in 1782, revealed to an incredulous world with astonishing suddenness, that flight through the air—the aspiration and object of endeavour for countless bygone ages, heretofore a tale of nought but unqualified failure, and commonly regarded as an impossible dream or an idle subject for ridicule—had at last become a wondrous achievement.

Black's Suggestion as to filling a Bladder, and Cavallo's Experiments, 1781.

The Balloon invented jointly by

The discovery of the balloon was the joint invention of two brothers, Joseph and Étienne Montgolfier, paper-makers of Annonay, near Lyons, though French authorities ascribe to Joseph the major

[1] See Faujas de St. Fond, *Description des Expériences de la Machine Aerostatique de MM. de Montgolfier, &c.* [vol. i], 1783, pp. xiii–xxii, for the actual text of passages from Galien's rare little treatise.

share of the discovery. Interested in the physical sciences and incited (as the elder brother records) to experiments in 'aérostation'—for so the principle of the balloon was at once termed—by reading Priestley's *Experiments on Air*, the two brothers first achieved success in November 1782 with small paper bags, or 'balons', inflated with hot air.[1] In April 1783 they repeated this success with a larger 'machine', and on June 5th following they gave their first memorable public demonstration at Annonay with a spherical balloon, 110 feet in circumference, made of paper-lined linen, which was inflated with common air heated by means of a fire, and ascended to about 6,000 feet. The success of this wholly novel experiment created widespread interest among the savants in Paris, and unprecedented enthusiasm among the people not only of France but throughout Europe in general.

Joseph Montgolfier (1740–1810) and Étienne Montgolfier (1745–99).

Their First Public Experiment, June 5, 1783.

The interest and curiosity thus aroused in Paris at once led Faujas de Saint-Fond, the geologist, to organize a public subscription, and he induced his distinguished contemporary, J.-A.-C. Charles, the physicist, to collaborate with two mechanics, the brothers Robert (who claimed to have devised a means of rendering silk impervious to hydrogen by the use of caoutchouc), in the construction of a small silk balloon, which they designed to inflate with inflammable air. After some difficulty in making sufficient gas, the experiment was accomplished on August 27th following, from the Champ de Mars, and the 'globe aérostatique' fell at Gonesse, about fifteen miles from Paris. Meanwhile the Montgolfiers, having constructed two much larger machines (one of which was destroyed by a storm), achieved at Versailles on September 19th the further distinction of being the first to launch into the air three living animals, a sheep, a cock, and a duck. Encaged in a wicker basket suspended beneath the balloon (the latter of cloth, painted within and without), these animals were carried to a height of about 1,500 feet and descended safely in the wood of Vaucresson, a distance of rather less than two miles covered in about eight minutes.

Experimental Hydrogen Balloon of Charles and Robert, Aug. 27, 1783.

But the triumph of the Montgolfiers appeared complete, when, on October 15th, in an oval balloon having a capacity of 60,000 cubic feet, constructed with a wicker gallery attached by cords, J.-F. Pilâtre de Rozier (1754–85), an accomplished young scientist and the world's first aeronaut, made a captive ascent to a height

Pilâtre de Rozier's First Ascents, Oct.–Nov. 1783.

[1] *Rapport fait à l'Académie des Sciences*, Dec. 23, 1783 (as cited by Cavallo, p. 44).

of about 80 feet from the Jardin Réveillon in the Faubourg St. Antoine, remaining in the air for 4 minutes 25 seconds. After further experimental captive ascents on October 17th—in one of which he was accompanied by Giroud de Villette—Pilâtre de Rozier, on November 21st, made his ever-memorable first free flight (in the same balloon) from the gardens of the Château de la Muette, with the Marquis d'Arlandes as a passenger. The two aeronauts were carried by the wind across Paris at a height of about 300 feet, and after twenty-five minutes landed in safety beyond the boulevards, a distance of over five and a half miles. The achievement must always be regarded as not less courageous than remarkable, seeing that during the flight the fire maintained in a brazier below the neck of the balloon set light to the fabric, and was extinguished by means of the sponge and water which Pilâtre de Rozier's cool foresight had provided.

Charles ascends in a Hydrogen Balloon, Dec. 1, 1783.

This exploit was, however, soon surpassed, for on December 1st Charles (accompanied by the elder Robert) ascended in the first man-carrying hydrogen balloon, spherical in form and 26 feet in diameter. It was constructed by the brothers Robert under the supervision of Charles, to whom is due the credit of having produced in his first machine those essential features—the valve, the net, the suspension of the car, the necessity of taking up ballast, and the use of the barometer, not to mention the gas—which are preserved in present-day practice. Indeed, it may be said that under the hand of Charles the balloon as an aeronautical instrument was produced with a degree of completeness that made further essential progress difficult—much as the invention of printing by Gutenberg sprang to perfection in the first production of typography. The balloon was released from the Tuileries Gardens, and after being in the air two hours it first descended at Nesle, about twenty-seven miles from Paris, whence Charles reascended by himself and rose very rapidly to over 9,000 feet—an alarming experience which, it is said, restrained this distinguished pioneer from ever making another flight. A final landing was made in safety not far from the point of the first descent at Nesle.

'Montgolfière' versus 'Charlière'.

The next few months witnessed the construction throughout France of numerous large balloons—both 'Montgolfières' and 'Charlières', as the two rival types were termed—in which ascents, for the most part successful, were achieved. The limitations of the 'hot-air' balloon soon led to an increase in size, the largest

of that type made by the Montgolfiers (and it is said the largest of its kind ever built), being the 'Flesselles', with a capacity of 23,000 cubic metres. It ascended, after some difficulty, from Lyons on January 19, 1784, when Joseph Montgolfier (on this sole occasion), with Pilâtre de Rozier and five passengers, experienced a short flight. In June another 'Montgolfière', 'La Gustave', ascended also from Lyons, the event being notable in that Mme. Tible, the first woman to go up in a balloon, was one of the passengers. But the disadvantages involved in the construction of large 'hot-air' balloons, their limited endurance in flight, and the dangers of carrying an open fire, quickly led to their being superseded by the hydrogen balloon. J.-P. Blanchard, who was destined to become the most widely known of the early aeronauts, made his first ascent in a balloon of this type on March 2, 1784, from the Champ de Mars, while Guyton de Morveau, a distinguished chemist, constructed another in June for the Académie de Dijon. In both exploits an attempt was made unsuccessfully to direct the balloons—a problem to which Montgolfier had already turned his attention. More important ventures in that direction were the ascent from St. Cloud of the first cylindrical balloon, constructed by the brothers Robert in July of the same year, and of a second similar balloon from the Tuileries in September.

Ballooning in Italy,

But before this date the extraordinary interest aroused by the invention had spread throughout Europe. In Italy the first balloon —an improved 'Montgolfière', with better provision for sustained heating—was constructed by the brothers Gerli, at the expense of Paolo Andreani, and successful ascents were made from Moncucco, near Milan, on February 25 and March 13, 1784. But these achievements were not, as in France, immediately followed by others, and Italy had to wait until later, when on the return of Lunardi and Zambeccari to their native country these two famous pioneers made further ascents at Rome, Naples, Bologna, and elsewhere. It may be added that ascents of some scientific interest were made by Pasquale Andreoli in 1807–10 at Milan, Padova, &c., and that from about 1825 onwards considerable ballooning activity was displayed by Francesco Orlandi of Bologna. But in general the early endeavours to exploit aerostation in Italy cannot compare in extent or interest with those achieved in France.

and in Great Britain.

In Great Britain the invention of the balloon also excited widespread interest, expressed in terms of curiosity and wonder, though

not unaccompanied by incredulity and even ridicule. Scientific opinion was, however, strangely apathetic (a fact noted with regret by Benjamin Franklin), and it was left to an Italian sailor of fortune, Count Francesco Zambeccari, to make the first public experiment in London. This he achieved with a small balloon of oil-silk, 10 feet in diameter, which, inflated with hydrogen and released from the Artillery Ground on November 25, 1783, descended about two hours later near Petworth in Sussex. The day following Aimé Argand, the Swiss savant, exhibited a similar balloon at Windsor Castle for the edification of George III, and thereafter the vogue for sending up small balloons, inflated either with 'hot air' or 'inflammable air', became general throughout England. Some months elapsed, however, before any serious attempt was made to ascend in a full-size balloon, though an endeavour to exploit public credulity made by a Swiss adventurer, the Chevalier de Moret, in the autumn of 1784, ended in a riot at Chelsea and involved the destruction of the 'Montgolfière' balloon.

Zambeccari's Experiment, Nov. 25, 1783

The first ascent in Great Britain, though attended with but limited success, was that achieved at Edinburgh by James Tytler, a hackwriter with some scientific attainments. On August 25, and again on September 1, 1784, he made two short flights or 'leaps' (to use Tytler's actual expression) in a 'fire-balloon' of his own construction. Indeed, it is clear that despite persistent endeavours he did little more than rise into the air, only to descend a short distance away, and in view of misfortunes and discouragement Tytler abandoned further efforts. It is equally clear, and better known, that the first 'aerial voyage' in England was successfully undertaken by a young Italian, Vincenzo Lunardi, on September 15th of the same year. Having constructed a silk balloon (without any valve) 30 feet in diameter, he inflated it with hydrogen and ascended from the Artillery Ground, Moorfields, in the presence of an immense crowd. After a flight lasting two hours and a half—during which he came to earth near North Mimms and reascended—he landed near Ware, in Hertfordshire, twenty-five miles from the place of ascent. Encouraged by his phenomenal success Lunardi made other balloons with which he ascended during 1785 from Liverpool, Edinburgh, Glasgow (and other places in Scotland), York, and Newcastle. But these ascents, though affording exhibitions of Lunardi's skill and daring as a pioneer balloonist, added but little to the science or technique

Tytler's Ascents at Edinburgh, Aug. 25 and Sept. 1, 1784.

Lunardi's Ascent in London, Sept. 15, 1784.

of the balloon. Indeed, save in so far as the numerous ascents which followed during the next few years involved the exploitation of the possible uses and capacity of the balloon, naught else resulted from them. The more notable of such ventures were Blanchard's voyage on October 16, 1784, from Chelsea, accompanied by Dr. John Sheldon (who landed at Sunbury, thus being the second Englishman to travel through the air), to Rumsey in Hampshire, and his more remarkable crossing of the English Channel with Dr. John Jeffries (an American physician who financed the expedition) on January 7th of the following year; the ascents of James Sadler, the 'father' of British balloonists, who rose in a 'Montgolfière' or 'fire-balloon' of his own construction at Oxford on October 4, 1784 (and was thus the first Englishman to rise into the air), and his more extended flight in a hydrogen balloon from the same city on November 12th following; the exploits of Major John Money (the first Englishman to write on the military aspects of the balloon) from Norwich during 1784, when on one occasion he narrowly escaped drowning in the North Sea; and Zambeccari's flight with Admiral Vernon on March 23 the same year, from London to Horsham, thirty-five miles, in less than an hour.

Holland. In Holland, where experiments with air-balloons had been made as early as December 1783, the first ascent was achieved by Blanchard at The Hague on July 12, 1785, when (owing to some small holes having been pierced in the envelope) he narrowly escaped disaster by striking against a chimney. On landing near Gouda the peasants almost wholly destroyed the balloon, but Blanchard nevertheless gave another exhibition at Rotterdam on the 30th of the same month. But beyond these ascents little was done in Holland during the early years of the invention.

Belgium. In Belgium likewise the first ascent was made by Blanchard at Ghent on November 20, 1785, followed by others at Brussels and Liége in 1786.

Germany. The first aerostatic experiments in Germany were apparently made early in 1784. In January a Benedictine monk, Ulrich Schiegg, sent up an experimental hot-air balloon (made of paper and oblong in form) at Ottobeuren, while two brothers named Bader, bookbinders by trade, released a small 'Montgolfière' balloon at Augsburg in February. But it was again the French aeronaut Blanchard who made the first ascent in Germany, at Frankfort (where he built an early form of hangar for protection against wind),

on October 3, 1785. Moreover, his subsequent exploits at Hamburg, Nuremberg (when a musical allegory was performed to commemorate the event), Leipzig, and Berlin—amongst other places—made during the years 1785–8, were the chief exhibitions of the kind seen in Germany. The only notable, it might almost be said notorious, attempt made by a native, was that of Freiherr von Lütgendorff in August 1786. Despite much heralding of the event—by way of prints and medals depicting the balloon in mid-air—the ascent of Lütgendorff's elaborate hydrogen balloon was apparently a complete failure.

To complete the tale of Blanchard's widespread and remarkable activities in exploiting the balloon—which, it may be added, left but little mark in the way of technical improvement—his career as a professional aeronaut carried him to Breslau and Prague in 1789–90, Warsaw in 1789, Vienna in 1791, and other Continental cities.[1] Crossing to America he made the first aerial voyage in the United States (some previous attempts were not wholly successful) from Philadelphia in January 1793, on which occasion General Washington was amongst the spectators.

The Utility of the Balloon.

Up to this point the early hopes which the invention of the balloon aroused had not been fulfilled—indeed, as it proved, they were destined to be disappointed. To be able to ascend high into the air was, after countless years of fruitless aspiration, rightly deemed a wondrous achievement, but when the first impression of wonder had worn off men asked what practical purpose the invention could be made to serve.

Scientific Ascents.

From the outset the possibilities of aerostation regarded as an instrument for the furtherance of scientific knowledge attracted attention. The great Swiss mathematician, Leonhard Euler, occupied his last hours in the autumn of 1783 in working out mathematical problems relating to balloons. Benjamin Franklin, one of the earliest scientific supporters of the balloon, wrote letters to Sir Joseph Banks describing the first ascents witnessed by him in Paris. 'In Natural Philosophy', wrote the anonymous author of *The Air Balloon*, 1783, the invention 'bids fair to make many great and considerable improvements'. The first scientific calculations as to velocity and altitude were made in England on the occasion of the ascent of Blanchard from Chelsea in October 1784 by Henry Cavendish, who subsequently

[1] The first ascent in Austria was made at Vienna on July 7, 1784, by J. G. Stuwer, a firework-maker.

analysed the samples of the upper air procured by Dr. Jeffries during his flight—perhaps the earliest balloon ascent used for scientific observations—with the same aeronaut in the following November. In 1803 Étienne Gaspard Robertson—who conceived the gigantic balloon he named 'La Minerve'—ascended from Hamburg in the French military balloon 'L'Entreprenant', and again from St. Petersburg with the scientist Saccharoff, the resulting observations on electricity and magnetism provoking considerable discussion. The controversy which ensued led to further scientific endeavours of the kind made from Paris (at the suggestion of Laplace) by Gay-Lussac and J.-B. Biot in 1804, in one of which an altitude of 22,892 feet was attained, with results of greater scientific value than those inaccurately recorded by Robertson. In particular the observations of Gay-Lussac showed that the magnetic force did not experience any appreciable variation at great heights, and that—as previously demonstrated by Cavendish—the composition of the upper air was the same as the air near the earth's surface.

The value of the data thus obtained was, however, insufficient to encourage other scientific ascents, and in France, as in England, nothing further of note was done until about 1850. In that year two savants, Barral and Bixio, made carefully organized ascents from the Observatory in Paris, during one of which they rose to over 23,000 feet. In 1852 John Welsh of the Kew Observatory made four ascents in Green's 'Nassau' balloon, while in 1589 the British Association organized the most important series of scientific balloon ascents ever made in this country. They were undertaken by James Glaisher in company with Henry Coxwell as pilot, and on six occasions an altitude of over 20,000 feet was recorded. The greatest height, namely about 37,000 feet, was attained on September 5, 1862, from Wolverhampton, on which famous occasion Glaisher became insensible, and it was with difficulty that Coxwell managed to pull the valve-line. Subsequently Glaisher made other ascents—twenty-eight in all, the last from Windsor in May 1866—his exhaustive observations being afterwards printed in the British Association Reports, 1862–6. Inspired by Glaisher's example Camille Flammarion undertook similar ascents from Paris in 1867–8, while in 1875 H. T. Sivel and J. E. Crocé-Spinelli lost their lives from asphyxiation during a high altitude ascent, when (together with G. Tissandier) they reached 27,950 feet. At a later date the great

expense of these scientific ascents and the dangers involved in rising to high altitudes led Gustave Hermite and Besançon to suggest (in 1892) the use of pilot balloons, or *ballons-sondes*, capable of carrying recording instruments to immense heights, with results which have answered the growing needs of English and Continental meteorologists.[1]

Military Ballooning.

Turning to the balloon regarded as a military machine, here again early anticipations were raised of far-reaching possibilities, which experience soon proved to be incapable of practical or general application. As a matter of fact the idea of aerial attack, as suggested in 1783, was by no means new—it found expression more than a hundred years before the first balloon ascended. Lana, in concluding the description of his 'aerial ship', conceived that God would not suffer such an invention to take effect, by reason of the disturbance it would cause to the civil government of men. 'For who sees not', he wrote (in the words of Hooke's translation),

Lana on Aerial Warfare, 1670.

> 'that no City can be secure against attack, since our Ship may at any time be placed directly over it, and descending down may discharge Souldiers, the same would happen to private Houses, and Ships on the Sea: for our Ship descending out of the Air to the Sails of Sea-Ships . . . it may over-set them, kill their men, burn their Ships by artificial Fire works and Fire-balls. And this they may do not only to Ships but to great Buildings, Castles, Cities, with such security that they which cast these things down from a height out of Gun-shot, cannot on the other side be offended by those from below.'

But Hooke was not perturbed by the mere description of 'so Diabolical an Engine', and having shown the fallacy of Lana's project he expressed the hope that he had thereby cleared the author from the imputation of 'doing any great harm by his invention to the Civil and Peaceful Government of the World'. The idea recurred, however, at a later date when Galien (as already mentioned) imagined his vast aerial machine as a means of transport for a large army, with its necessary equipment and provisions.

First Use of Military Balloons in France,

The idea of using the balloon for military reconnaissance occurred (at the very birth of the balloon) to Giroud de Villette, as the result of his experience in a captive ascent with Pilâtre de Rozier in October 1783. Other speculations on the subject soon followed. Montgolfier suggested the use of balloons as a method of communicating with the garrison of Gibraltar, while a treatise entitled

[1] In quite recent years small rubber pilot balloons, with recording instruments attached, have been known to rise to an altitude of nearly twenty-two miles.

L'Art de la Guerre changé par l'usage de Machines Aérostatiques was published anonymously (and a little prematurely) in the year following. But it was not until nearly nine years later that Guyton de Morveau, a distinguished chemist, proposed to the Convention the use of captive balloons in warfare. The difficulties of inflation—ever the chief drawback to the use of the balloon in the field—having been mitigated with the help of Lavoisier and Charles, Captain Coutelle was instructed in April 1794 to carry out experiments at Meudon. Ultimately this led to the formation of a balloon division, and in the following June Coutelle, having joined the Moselle army under the command of General Jourdan, made ascents during the battle of Fleurus, in Belgium, and remained in the air several hours. The information which he signalled to Jourdan proved to be a material factor in the far-reaching victory which the French forces gained over the Allies, and the achievement was repeated in the subsequent battle on the Ourthe, near Liége, when the French defeated the Austrians. These successes appeared to warrant an extended use of this new arm, with the result that the personnel of the 'Company of Aérostiers' was enlarged, and a new cylindrical balloon constructed. But though reconnaissance ascents were made during the siege of Mayence and elsewhere in 1796–7, and Coutelle was ordered to Egypt by Napoleon in 1798 (when the balloon materials were destroyed in the naval battle of Aboukir Bay), the results were limited and discouraging, and the 'Aérostiers' were disbanded in 1799. Thereafter nothing further of note was done in France for over fifty years.

at the Battles of Fleurus, June 26, 1794,

and Liége.

In England no attempt was made in these early days to test the possibilities of the balloon for military purposes—thus opening the long story of British governmental and military indifference to aeronautical science. Nevertheless, the idea was suggested as early as November 1783 by the writer of *The Air Balloon*, who conceived that in making observations by land or sea, at sieges, or in a war of posts (as in the case of Burgoyne's disastrous march on Albany in 1777), balloons might be usefully employed. A year later Thomas Martyn, in his *Hints on Aerostatic Globes*, urged their use as a means of increasing the safety of both fleets and armies, particularly the former, his suggestion as to their employment from the deck of a ship being probably the earliest of the kind. In 1803 General John Money wrote his *Short Treatise on Balloons in Military Operations*, but the only answer forthcoming from the

Discountenanced in England.

authorities was the answer Money anticipated, namely 'that as we have done hitherto very well without them, we may still do without them'. Broadly speaking that attitude continued down to 1862, when as the result of his ardent advocacy of 'balloons for warfare', Henry Coxwell was engaged to undertake experiments at Aldershot. His ideas (as originally explained in 1854) involved the use of captive balloons of 50,000 cubic feet capacity for reconnaissance and signalling, and for use in dropping heavy charges of explosives over an enemy's lines, an operation which he was probably the first to demonstrate (during his visit to Berlin) as early as 1848. Though Coxwell's experiments were not seriously followed up by the English military authorities, he was invited by the German Government on the outbreak of the Franco-German War in 1870 to undertake the instruction of two balloon detachments at Cologne. But in the outcome neither the German nor the French military balloons accomplished work of any tactical value on the battlefield. On the other hand the 'ballon poste' organized by the French during the siege of Paris (1870–1), though of civil rather than military importance, undoubtedly led to a revival of interest in the balloon, and incidentally emphasized the necessity for achieving control.

Coxwell's Experiments at Aldershot, 1862.

Balloons in the Franco-German War, 1870–1.

Disabilities of Captive Balloons.

In a general way it may be said that the difficulties of transport (chiefly due to the plant for generating gas), the time occupied in inflation, and the limitations imposed by meteorological conditions, were greater objections to the use of captive war balloons than the small advantages they offered. For instance, in the earlier period of the American Civil War (1861) balloons were used in the Federal army under McClellan, and a certain amount of useful information thereby obtained. But the transportation of the two balloons and gear, two heavy generators, and an acid cart, coupled with the fact that the inflation occupied approximately three hours, led to their disuse before the conclusion of the campaign. Indeed, in the armies of the Continental military powers, as in the British army, it was not until about 1880 that balloon sections began to form part of the service establishments. One other aspect of military ballooning at this period calls for notice, namely the use of the captive kite-balloon, designed to overcome the difficulty of handling a spherical balloon in a wind. Some form of the idea was suggested in 1844 by Abel Transon, a French mining engineer, but the modern type of kite-balloon (originally 'Drachen-ballon') and first used in

manœuvres in 1897, was due to von Parseval, a German officer, and H. B. von Sigsfeld, though somewhat earlier Godard designed a 'ballon cerf-volant ovoïde' on a similar principle.[1]

Ballooning in Europe during the 19th Century.

Reverting to the history of ballooning in general during the nineteenth century, it must suffice to record that the free balloon as an aeronautical machine was not improved—indeed was hardly capable of improvement—save in one or two respects. Though the idea of constructing a navigable balloon of the spherical type gradually passed away, nevertheless, in England and abroad, various novel devices were suggested or tried from time to time. Many of these revived the earlier attempts to overcome the limitations imposed by the inevitable loss of gas and loss of ballast, resulting from the necessity of checking those alternations of rise and fall which constitute the normal course, and incidentally determine the length, of every balloon voyage. Other improvements were of a more strictly technical kind—the operation of the valve, and so forth. The introduction of the use of coal-gas in 1821 by Charles Green—one of the most notable pilots in the annals of ballooning—was certainly the most important improvement—one which both expedited the process of inflation and made for reliability. The same aeronaut's demonstration of the uses of the trail-rope (the idea of which had been first suggested by Baldwin in his *Airopaidia*, 1785, and which Green originally termed a 'guide-rope') was also an addition of greater practical value than many more complicated devices. But in essential characteristics—spherical shape, valve, varnished or rubberised silk envelope, net and rope suspension of the car, and sand-ballast—the balloon of say 1880 differed but little from the balloon of 1800 or even of 1783.

Improvements fail to extend its Utility.

Mainly used for Purposes of Amusement.

As the century progressed the limited utility of the balloon (despite improvements) was increasingly realized, and in general estimation it came to be regarded merely as a spectacular attraction at public gardens and other places of amusement. As the novelty of ascents for such purposes lessened, endeavours were made to stimulate its attractions by recourse to sensational feats—night ascents with fireworks, ascents on horseback, or with wild animals, and the like. In the latter half of the century Henry

[1] M. Chas. Dollfus has suggested that Godard may have got his idea from a remarkable design for a kite-balloon described by Alphonse Penaud in 1874. Moedebeck gives a good summary of the development of military ballooning in the armies of the continental powers, &c. (edition 1907, Ch. ix). Cf. Hildebrandt, Chs xii–xv.

Coxwell in England sought to redeem the balloon from this degraded character by advocating its use not only (as aforesaid) for military purposes but also for scientific—chiefly meteorological—observations. Following in the footsteps of Charles Green—though with larger aims—Coxwell carried the technique of ballooning to a high point of efficiency, which was maintained towards the close of the century by the brothers Spencer, who added to skilful pilotage the manufacture of all kinds of balloons on a large scale. On the continent—more particularly in France and Italy—as in America, the activities of professional balloonists were also mainly confined to exhibitions for public amusement. In the United States John Wise accomplished during a long career a large number of ascents, perhaps the most remarkable being that made in 1859, when he travelled 1,120 miles from St. Louis to Henderson, N.Y. But in the main his exploits were unimportant, though occasionally they were of an exciting character, some dangerous experiences of the latter kind leading him (about 1845) to the first suggestion of a form of ripping-cord. Achievements of a more practical kind were made possible to French aeronauts during the siege of Paris, in the systematic if hazardous use of balloons for purposes of escape from a confined area and for postal communication. These achievements were the work of a group of scientific and practical balloonists, including Albert and Gaston Tissandier, Wilfrid de Fonvielle, Nadar (otherwise Félix Tournachon), Henri Giffard, and Eugène and Jules Godard. The first named were ardent advocates in the cause of lighter-than-air aeronautics, while Nadar, an equally fervent apostle of the newer 'plus lourd que l'air' school, adopted the anomalous method of constructing the 'Géant', one of the largest balloons ever made—and the last, as his faith in the early accomplishment of the alternative method led him to affirm—for the purposes of raising funds to forward his projects on mechanical flight. Giffard, best known for his steam-driven dirigible of 1852, also built a huge balloon—capable of lifting twenty people, and used as a captive machine at the Paris Exposition of 1867—for a similar purpose. Eugène Godard—one of a well-known family of aeronauts—likewise constructed a large hot-air or 'Montgolfière' balloon, called 'L'Aigle', a peculiar feature of which was the parachute-like fringe fitted round the circumference of the balloon.

But all these, and countless similar activities in the ballooning world, led to naught, and before the close of the century the balloon

was again relegated to the idle purposes of fine-weather amusement. Indeed, its familiar appearance—a harmless, placid, even attractive object, floating serenely and unconcernedly in the sky, subject always to the whims of changing currents or the mercy of strong winds, and carried here or there or (in a calm) nowhere—affords an appropriate symbol of its own inherent characteristics. Nevertheless, in passing from the free balloon justice requires that a measure of appreciation be accorded not only to the first pioneers—whose courage in exploiting a novel machine of unknown qualities moving in an equally unknown element it is not easy at this date to realize—but also to those later pilots who strove to make of the balloon more than its limitations would allow, who were from time to time subjected to the dangers or suffered the death incident to their calling, and whose experiences served (not least) to build up some such tradition among the pilots of the air, as had long since animated the spirit of all pilots and sailors on the sea.

GENERAL SURVEY

PART II

THE NAVIGABLE BALLOON—THE FLYING MACHINE

The Problem of the Navigable Balloon from 1783 onwards.

THE limitations of the free balloon as a means of aerial travel—in particular the limitations imposed by its complete subservience to the winds—were realized at a very early date. Within a few months of the invention the problem of devising some method of control engaged active attention in France, both theoretical and practical, and called forth speculation in England and Italy. In the first stages of enthusiasm and hope the difficulties were greatly underrated, and hence wellnigh countless projects sprang from the minds of scientists, mechanicians, and men of ingenious and inventive proclivities. Broadly speaking such endeavours may be divided into two categories. The first, though of lesser importance, arose from the parallel suggested by the idea of the boat floating on the water and navigated by the use of sails and rudder, a notion which had appeared in an immature form for the first time in the illustration of Lana's 'flying boat', 1670.[1] Various applications of this method appear in engravings of the period under discussion, but it was one which, based on a false analogy (inasmuch as the boat moves in two elements of different density, whereas the balloon moves wholly in one), was so obviously futile when applied to aerial navigation that it is doubtful whether it was ever even attempted.[2] Equally futile—though in aim more nearly akin to the following than within this first category—was the idea of drawing balloons through the air by means of trained eagles or other large birds. The avian notion as applied to imaginative aerial chariots was of very ancient origin,[3] but it was first suggested in connexion with balloons by Jacob Kaiserer of Vienna in 1801, and was revived with strange persistence during the century by other imaginative projectors both in France and England.[4]

The Use of Sails and Rudder.

The Idea of Propulsion.

In the second category the more scientific pioneers sought to overcome the initial difficulty—erroneously regarded as arising

[1] See Fig. 7. Also Bruel, no. 13.

[2] E. g. Fig. 110, also see Bruel, nos. 83, 85, 86, 87, and Grand Carteret, p. 138.

[3] The aerial flight, by means of four griffins, as recounted in the romance of Alexander (third century, or earlier) is a notable instance.

[4] See Fig. 113, also Grand Carteret, pp. 10 and 65; La Vaulx, no. 59.

from the lack of a *point d'appui* (or fulcrum) in the air, and falsely demonstrated in the abortive use of sails—by the application of some propulsive force. Simultaneously this idea involved the question of form or shape, which at an early stage led to the conclusion that navigable balloons should be cylindrical, ellipsoidal, or (to use a current term) fish-formed.[1] Oars and wings were the earliest forms of mechanism devised and tested for the purpose of propulsion, but they soon proved to be unavailing. There followed other suggestions and some actual trials in the direction of turning to account the known resistance offered by the air, on which principle the propelling power was to be got either from the emission of a jet of hot air (at a later date steam was proposed) on the principle of the aeolipyle of the ancients, or by the explosive reaction of gunpowder fired in the form of rockets—two ideas which were revived from time to time up to the middle of the nineteenth century.[2] A far more important mechanical suggestion (first made by Meusnier in 1784) was the application of the screw as a propeller—a project destined in due time to afford the means of solving the problem of dirigibility, but one which at that early period emanated from Meusnier alone, though Blanchard's use of a *moulinet* (or revolving fan), and the proposed use of paddle-wheels, were of similar intent.[3] Another method—first suggested by David Bourgeois in 1784, and also recurring in later times—involved the use of an adjustable plane surface fitted beneath the balloon, whereby some measure of control might be obtained from the horizontal pressure of air on such plane during the rise or fall of the balloon.[4]

[1] One of the earliest designs (published as an engraving in Apr. 1784; see La Vaulx, no. 16) was that of Mathieu, a mechanician. This 'Nouvelle forme de Globe Aèrostatique' was oval in shape, with a large rudder at one end. See also Guyot [probably the Abbé Guillaume-Germain Guyot (1724–1800)], *Essai sur la Construction des Ballons Aerostatiques et sur la Manière de les diriger*, 1784. The frontispiece (Lecornu, p. 86) shows an ovoid balloon, the pointed end astern. The 'aerostatic fish' first appeared in a pamphlet entitled *Lettre à Mr. M. de Saint-Just sur le Globe Aërostatique de MM. Montgolfier*, 1784 (Bruel, no. 202).

[2] The aeolipyle (the invention of Hero of Alexander) was a pneumatic instrument illustrating the force with which hot air confined in a close vessel rushes out by a narrow aperture. The name (*Aeoli pylus*, the doorway of Aeolus) was suggested by the winds rushing from the opened door of the cave of Aeolus.

[3] Carra (J.-L.), *Essai sur la nautique aérienne. . . . Lu à l'Académie Royale des Sciences de Paris*, Jan. 14, 1784. The frontispiece to the book is reproduced by Grand Carteret, p. 60.

[4] The idea of reversible inclined planes as applied to balloons engaged the attention of Montgolfier in France and Cayley in England. L.-C. Guillié (in 1814) designed an ovoid

The Loss of Gas and Ballast.

As connected with the last-named scheme and bearing on the problem of control, various devices were conceived with the idea of avoiding the limitations involved in the expansion and resultant loss of gas—either through the valve or the appendix and in the equivalent loss of ballast. These devices, as numerous as they were varied and forthcoming down to a late period in the nineteenth century, were directed towards vertical rather than horizontal control—a desideratum which experience must have revealed to the earliest pioneers of the hydrogen balloon. But they concerned dirigibility in an indirect sense only, inasmuch as the properties of gas in respect to expansion and diffusion affect the free balloon and the navigable balloon alike, and govern the duration and altitude, but not the direction of flight.

The Lack of a Prime Mover.

On the main question of the dirigible balloon it may be said in a general sense that the difficulty which rendered unavailing the efforts of early pioneers down to the middle of the nineteenth century was the lack of adequate propulsive power. That insuperable obstacle was the main cause of all the failures, these in turn leading to an extraordinary diversity of design with little or nothing in common save the want of a 'prime mover'.

Early Projects in France.

Turning from general principles to particular endeavours, France, as the home of the invention of aerostation, led the way in theoretical ideas and practical attempts. The earliest projects were mainly of the former character, and though they seldom developed beyond the facilities of exposition afforded by ink and paper, they proved attractive to that type of inventor who has no intention of incurring the travail of experiment or the possibilities of failure involved in a practical test. Doubtless such contributions to the problem as appeared from the end of 1783 onwards, albeit usually theoretical in the highest degree, led to discussions from which there gradually emerged a true understanding of the principles involved. Nevertheless they may, for the most part, be disregarded in this survey.

Meusnier's Airship Design, 1783–4.

A notable exception must be made in the case of the interesting series of designs for a dirigible balloon, prepared by General Jean-Baptiste-Marie Meusnier (1754–93), one of the most remarkable

balloon with pointed planes at either end, the inclination of the whole machine controlled by cords and pulleys from the car (cf. Lecornu, p. 139, and Grand Carteret, p. 105). The principle was applied with great elaboration to the project of G. Rebenstein of Nuremberg in 1835. (See Moedebeck, p. 323.)

Frenchmen of his time, equally distinguished in military, scientific, and mechanical achievements. As early as December 3, 1783, he presented to the academy a memoir on aerostatic machines, wherein he first explained his suggestion to use a ballonnet which could be filled (by means of a pump) with common air, or emptied as required—an idea erroneously conceived as a means of controlling the height, and not (as in modern non-rigids) to maintain the shape by pressure.[1] The following year he produced a series of fifteen drawings for the design of an ellipsoidal balloon—260 feet in length and with a capacity of 60,000 cubic feet—in which he not only incorporated the idea of pumping air into an outer envelope, for purposes of stability and pressure, but suggested the use of three *rames tournantes*, or air-screws, to be worked by manual power. Moreover he paid attention to the triangular (or indeformable) suspension of the gondola or car, and worked out methods of landing, with a portable canvas *pavillon*, or tent, for protection against wind. It is true that, owing to the prohibitive expense of construction, Meusnier's designs remained merely as designs, but they entitle him to a high place in the early history of the science of the airship.

Robert's Cylindrical Balloon, July–Sept. 1784.

The only practical attempt to apply Meusnier's idea of a ballonnet was that made at the expense of the Duc de Chartres by the brothers Robert, who were the first to construct a cylindrical or elongated balloon, 52 feet in length, with a capacity of 28,274 cubic feet, that of the ballonnet being 3,571 cubic feet.[2] In it they ascended from St. Cloud on July 15, 1784, but the means of propulsion, namely five ' oars ' (in the form of parasols), proved utterly insufficient, and a catastrophe—arising from the great pressure of gas—was narrowly averted by the Duc de Chartres, who pierced a hole in the silk envelope with the staff of a flag. A second trial of the same or a similar elongated balloon was made from the Tuileries on September 19 of the same year, when the balloon was carried as far as Beauvry, near Béthune. But neither experience had any value except of a purely negative kind, as bearing on the problem of control.

About two months earlier the first actual attempt to navigate

[1] Meusnier (J.-B.-M.), *Mémoire sur l'équilibre des Machines aérostatiques*, &c., 1784. See *I. L. A.*, nos. 980 and 981 (the latter being a detailed description of the design), and Bruel, nos. 149–50. Cf. also Marey-Monge (E.), *Études sur l'Aérostation*, 1847, pp. 98–105 ; Lecornu, pp. 98–100 ; and Berget, *The Conquest of the Air*, 1909, p. 82. Meusnier's original water-colour designs are preserved in the Aeronautical Museum at Chalais-Meudon.

[2] Meusnier (op. cit.), p. 48.

Blanchard's Attempt to direct a Balloon, March 1784.

a balloon 'contre le vent' was made from Paris by J. P. Blanchard. Blanchard conceived the idea of adapting the wings and rudder constructed for his 'vaisseau volant' or flying machine, but as a result of unforeseen accidents which reduced the lift of the balloon he was obliged to discard the greater part of the mechanism before the ascent. Despite his failure he continued for some time (successfully as he avowed) to make use of oars, which consisted of a light framework covered with silk. At a later date he substituted a small *moulinet*, or revolving fan, which he was also the first to use.[1]

Miolan and Janinet's Montgolfière, July 11, 1784.

The following July witnessed the first attempt, made by Miolan and Janinet, to construct a dirigible 'Montgolfière', which they designed to propel by means of jets of hot air escaping from the meridian of the balloon, combined with the use of a large fan-shaped rudder—an attempt disastrously essayed in the Luxembourg, when the failure of the project provoked a riot followed by the burning of the machine.[2] A more scientifically organized endeavour was that associated with L. B. Guyton de Morveau (1737–1816), a distinguished physicist and chemist, who as early as December 1783 undertook experiments at the instance of the Academy of Dijon, designed to elucidate the question of directing balloons. Incidentally Guyton de Morveau about the same time suggested using the ascensive power of the balloon as a means of drawing water from mines—an idea which affords a parallel to Savery's first application of the steam-engine for a similar purpose—and the year following he is said to have conceived the possibility of constructing a metal balloon.

The 'Aérostat de Dijon', June 12, 1784.

The Dijon balloon was fitted with two oblong horizontal surfaces or wings fastened to the circumference of the envelope—the one to act as the prow and the other as a rudder, with two smaller wings in a similar position on either side to serve for propulsion, aided by a pair of oars worked from the car. Several trials were carried out in the summer of 1784, but despite the modest claims made by Guyton de Morveau—who fully appreciated the difficulties—in his report to the academy, these endeavours must have fully demonstrated the impracticability of this and of the many similar designs.[3] Indeed out of no less than a hundred and one memoirs submitted

[1] Tissandier, vol. i, p. 62; Bruel, nos. 73–7. Dr. Potain fitted a similar fan to the balloon in which he attempted to cross the Irish Sea in June 1785. See *post*, Ch. VII, p. 177.

[2] Lecornu, p. 93; Bruel, nos. 90–6.

[3] De Morveau, Chaussier et Bertrand, *Description de l'Aérostat L'Académie de Dijon*, 1784; Lecornu, pp 90–2; Bruel, no. 110.

to the Academy of Lyons in March 1785 in connexion with a prize offered for an essay on 'la manière la moins dispendieuse et la plus efficace de diriger à volonté les machines aérostatiques', not one was considered worthy of the prize.

Baron Scott's Fish-shaped Balloon, 1789.

As the difficulties of the problem became apparent, projects notably diminished. The oblong form and the possibilities of air-ballonets were amongst the few inventive ideas which survived. A design on these lines was described by Baron Scott, an officer in the Dragoons, in a work entitled *Aérostat dirigeable à volonté*, 1789. The chief feature in Scott's fish-shaped balloon was the endeavour to attain some measure of dirigibility by fitting two air-pockets fore and aft, either of which could be drawn into the envelope, thus increasing or diminishing the lift in the opposite end. By the alternate use of these ballonnets—the idea of them doubtless adapted from Meusnier—Scott hoped to obtain an alternating inclination, first in ascent and then in descent, which with the help of oars would give a forward motion to his machine.[1] Scott's design is said to have inspired S. J. Pauly, a Genevan gunsmith, who constructed a 'fish-formed' balloon in 1804, from the car of which he proposed to manipulate some form of wings or revolving oars. Trials conducted at Sceaux appear to have afforded some encouragement, though his efforts were thwarted by reasons of expense—the second great obstacle in all endeavours to advance the science of air-ships by practical trials. However in 1815 he came to London, and in conjunction with Durs Egg made a second interesting and more ambitious venture, the so-called 'Dolphin Balloon', in which he first proposed the use of movable ballast—suspended between the tail of the goldbeater's-skin envelope and the car—as a means of raising or depressing the nose of the balloon.[2]

Pauly's Fish-formed Balloon, 1804.

Genet's 'Ballon à chevaux', 1825

The question of propulsion and the realization that the application of manual power as hitherto tried was quite inadequate led to such schemes as the 'Ballon à chevaux' of E.-C. Genet, a French scientist, in 1825. From beneath the balloon—in the form of an

[1] Lecornu, p. 109. Scott's designs show, perhaps for the first time, the angle which a dirigible must take when in a 'position ascendante' or 'position descendante'. The principle of the 'air-pockets' was adapted in the Parseval non-rigid airships (1908) which had no elevators. A cylindrical balloon, with semi-spherical ends, was used by P. Testu-Brissy for an equestrian ascent in 1798, but presumably only because this form allowed of the better suspension of a platform in place of a car. (See Bruel, no. 173.)

[2] Grand Carteret, p. 123. An account of Pauly's venture in London (which was abandoned before completion) is given in Ch. XIII.

elongated dome 152 feet long—Genet proposed to suspend a long platform, in the centre of which was a wheel sufficiently large to allow of its being actuated by two horses, the power thus exerted being conveyed by gearing to two paddle-wheels.[1] Paddle-wheels supplemented by oars (both actuated by manual power) also appeared in the *ballon-navire*, 'L'Aigle', built by the Comte de Lennox, in 1834, in collaboration with Le Berrier, a doctor from Havre, who had devoted many years and all his wealth to the construction of a dirigible balloon. 'The Eagle' was in form cylindrical with conical ends, 130 feet long and 35 feet in diameter—fitted with an air-ballonnet of 200 cubic metres—and when inflated with hydrogen was designed to have a lifting power of 6,500 lb. By means of the air-ballonnets and a cushion of air extending the length of the envelope (above the *nacelle*), Lennox hoped to control the altitude of the balloon, and by so doing to take advantage of favourable currents of air—an idea which had been suggested by Meusnier in 1783, and which in later periods was renewed in connexion with the free balloon.[2] In a calm or a *vent ordinaire* he estimated that the use of twenty oars and other mechanism would give a speed of about five miles per hour. A trial arranged for August 17, 1834, on the Champ de Mars, was delayed owing to the envelope getting damaged, whereupon the impatience of an immense crowd grew beyond restraint and the balloon was completely destroyed.[3] Not wholly discouraged Lennox renewed his endeavours in London the following year, but though he constructed another airship on similar lines he never tried it.

Count Lennox's 'Eagle' Airship, 1834.

Petin's Navire Aérien, 1850–1.

These more serious and rational endeavours were accompanied, from time to time, by all manner of fantastic schemes. A pretentious project was that of Ernest Petin (1812–78), the proprietor of a millinery business in Paris, to whom the subject of dirigible balloons became almost an obsession, and whose schemes evoked a remarkable amount of public interest. He conceived (in 1850) an 'airship' formed of four spherical balloons (supported on either side by inclined planes for use in ascent and descent) secured to a rigid keel and propelled by means of Archimedian screws to be actuated either by manual or other power. But Petin's ambitious design was

[1] Lecornu, p. 142.

[2] Amongst others Charles Green believed in the practicability of navigating balloons from place to place, based on his experience of varying currents of air at different altitudes.

[3] La Landelle (where some details are inaccurate), p. 134; Lecornu, p. 143; La Vaulx, no. 57. Lennox's further endeavours in London are related in Ch. XIII.

never tested beyond actual construction, and eventually both the inventor and his project became wholly discredited.[1] Somewhat earlier a revival of the 'fish-formed' dirigible appeared in a design by A. J. Sanson, who proposed to ascend (the balloon being in equilibrium) by means of wings, to obtain propulsion by four small paddle-wheels, and to steer by means of a large triangular rudder.[2] A similar shape was also adopted in 1859 by Camille Vert, a mechanic, who designed a *poisson volant*, with a model of which he gave public demonstrations. Motive power was to be obtained from a steam-engine driving two propellers fore and aft of the car, control being effected by adjustable planes fitted behind the air-screws, and a rudder on the centre line astern.[3]

Sanson's Ballon-Poisson, 1840–50.

Jullien's 'Précurseur', 1851.

Despite the lack of success, which in a greater or less degree attended all endeavours up to about 1850—at which period there was a marked revival of interest in dirigible balloons—the evolution of the airship was being gradually worked out. Indeed the modern beginnings of the science may reasonably be said to date from the experiments, albeit only on model scale, conducted in the Hippodrome at Paris during 1850, by Pierre Jullien, a clockmaker of Villejuif. Jullien's model airship, which he fittingly named 'Le Précurseur', was elongated in form—a clean, streamline shape, tapering to the stern as in modern practice—with propellers either side on the centre line, actuated by clock-work. It has been justly said that Jullien's conceptions—the maintenance of the form, the suspension, the position of the propellers, and also of both rudder and elevators—were the work of a designer gifted with something akin to genius, and Giffard himself paid a tribute to his contemporary in admitting his indebtedness to 'Le Précurseur'.[4] Despite the fact that in 1851 he was obliged to abandon the idea of constructing his design on full scale, Jullien's model experiments, combined with his sound appreciation of main principles, entitle him to a place as a true pioneer of the airship. Moreover Jullien's efforts doubtless contributed to the success first achieved by

[1] Lecornu, p. 170, and La Landelle, p. 142. The idea of using multiple balloons in a dirigible design was suggested by L. J. Stoupy-Bijou in 1784. (See Bruel, no. 86.) In 1828–30 Bayer, in a scheme even more fantastic, suggested the combination of nineteen small balloons enclosed within an outer envelope (Grand Carteret, p. 113). Dupuis-Delcourt (p. 254) made experiments in 1824 with a 'flotille aérienne'—a main balloon and four smaller ones. But here the idea was to take advantage of upper currents, though without success.

[2] Lecornu, p. 174.

[3] Ibid., p. 183. Vert showed his model at the Aeronautical Exhib. of 1868. See p. 282 *post*.

[4] La Vaulx, no. 60; also Lecornu, p. 175.

Giffard's First Dirigible Balloon, Sept. 24, 1852.

Henri Giffard (1825–82), a distinguished engineer, who has been designated the 'Fulton of aerial navigation', but is more widely known as the inventor of the injector which bears his name. Having worked with Le Berrier (Lennox's colleague in the 'Eagle' project of 1834), Giffard made his first ascent in a free balloon in 1851, in company with the well-known pilot Eugène Godard. In the same year he constructed a small light-weight steam-engine of three horse-power, and subsequently, when applying for a patent in respect of the 'application de la vapeur à la navigation aérienne', he described in connexion therewith a model oblong aerostat with a screw propeller driven by steam. In 1852 he designed and built a full-scale dirigible elongated in form (with pointed ends), about 144 feet long and 40 feet diameter in the centre, and with a capacity of 88,000 cubic feet. Suspended about 20 feet beneath the envelope was a small single-cylinder steam-engine of three horse-power (with a vertical boiler and enclosed fire-box) driving a three-bladed propeller at 110 revolutions a minute, and giving a speed of about six miles per hour. On September 24th Giffard ascended from the Hippodrome, Paris, and after a successful flight, during which the dirigible was proved to be capable of an appreciable measure of control in a light wind, he landed safely near Trappes. In 1855 he made a larger airship, which, however, was not as successful as his first venture, and though (after having made a large fortune by the invention of his injector) he devoted much time and money to aerostation, his later endeavours added nothing to the solution of the problem he had been the first to overcome on a limited scale.[1]

Dupuy de Lôme's Dirigible, 1872.

Giffard's achievement had at least proved beyond doubt that given adequate motive power the airship was a practicable method of aerial navigation. But the engine to afford that power was not yet forthcoming; and for lack of it Dupuy de Lôme (1816–85), in the remarkable dirigible which he constructed in 1872, was obliged to revert to manual power. His airship was originally conceived in 1870 as an endeavour to overcome the limitations of the free balloons used during the siege of Paris, but the capitulation put an end to his endeavours. Two years later he set to work again and constructed a small dirigible—in form similar to that of Giffard, but about 108 feet long and 47 feet in diameter—beneath which,

[1] Lecornu, p. 176, &c.; La Landelle, p. 154; Hildebrandt, p. 48; La Vaulx, no. 63 Giffard described his dirigible in the *Comptes rendus de l'Académie des Sciences*, Paris, 1870, vol. i. At a later date (in 1868 and again in 1878) his name was associated with two immense captive balloons.

by means of a new form of triangular suspension, he fitted a car with a large four-bladed propeller, actuated by a windlass worked by eight men.[1] The first and only trial was made from the fort of Vincennes on February 2, 1872, and was successful in so far that a deviation was effected of 10–12° from the direction of the wind, and a safe landing made at Mondécourt on the confines of the Aisne and the Oise. It has been truly said of Dupuy de Lôme (who was a leading naval architect of his day, and the first to apply the experience of that profession to aeronautics) that his dirigible exhibited all 'the principal features of our modern non-rigids in their fundamental forms': control and stability, suspension system, ballonnet and blower, with an envelope of two-ply rubberised and doped fabric.[2] Though his ideas on the application of power were retrogressive compared with Giffard, he otherwise achieved as much as the mechanical conditions of his day permitted, and pending the development of the internal combustion engine little further could be done. One or two other endeavours made in the interval may, however be related in conclusion.

In 1882 two brothers, Gaston and Albert Tissandier, who had been interested in the subject since the siege of Paris, constructed a dirigible on similar lines to that of Dupuy de Lôme, in the car of which they fitted a Siemens electric motor of one and a half horse-power, the current obtained from bichromate of potash batteries. The first trial was made from Auteuil on October 8, 1883, when despite the wind a certain deviation was obtained by use of the rudder, while a second test on September 26th the following year gave rather better results. But a slight wind was sufficient to render the motor ineffective, and the experiments were abandoned.[3] A year later, however, an electric motor of eight horse-power was applied with greater success by Charles Renard (1847–1905) and A. C. Krebs, a French officer, the former an engineer of exceptional ability and at one time director of the military balloon establishment at Chalais-Meudon, near Paris. They designed and constructed a torpedo-shaped dirigible—to which they gave the name 'La France'—165 feet in length and about 27 feet at its greatest diameter, which (differing from the foregoing types) was forward of the centre and tapered towards the stern. The 23-foot

Tissandier's Dirigible, 1883.

Renard and Krebs' 'La France', 1884.

[1] Lecornu, p. 296; Tissandier, vol. ii, p. 134; La Vaulx, no. 63.

[2] Hunsaker (Commander J. C.), 'Naval Architecture in Aeronautics' (in *Aeronaut. Journal*, vol. xxiv, 1920, p. 332).

[3] Tissandier, vol. ii, p. 137, &c.; La Vaulx, no. 64.

propeller—driven from chromium chloride batteries and giving an air speed of fourteen and a half miles per hour—was fitted as a tractor screw in front of the car, a sliding weight was used for purposes of horizontal stability, and the rudder was provided beneath the envelope at the rear of the car, the suspension being effected by parallel cords. The earliest trial made from Chalais-Meudon on August 9, 1884, proved successful, and for the first time in the history of airships a return was made to the point of ascent. Six other trials followed during 1884–5, and though the initial success was repeated on four occasions, the relatively low power and great weight of the motor and accumulators proved that electric propulsion did not meet the requirements of a dirigible intended to fly long distances. The first step in the final stage of the development of the airship as a method of true navigation in the air was achieved in 1898, when Santos-Dumont fitted a petrol motor to his first small dirigible.

Such in outline is the story of the evolution of the airship from the free balloon of 1783 as it unfolded in France. Though the survey thus far would serve to typify the general trend of development elsewhere, it will afford a more comprehensive view to summarize the contributions made and the progress achieved over the same period in other countries of Europe.

The Dirigible in England.

In England the earlier endeavours were not (as will be seen in a later chapter) as numerous or as seriously regarded as those which mark the attempts made by scientists and others in France to overcome the difficulties inherent in the problem of the dirigible. The beginnings were of the same futile character—indeed Thomas Martyn's design of 1783, depicting a spherical balloon with bellying sails and boat-like rudder, was one of the first of its kind.[1] The earliest practical attempts at direction were made with the use of oars, a method adopted—as Cavallo realized, 'with very little effect'—by Lunardi and Zambeccari, and doubtless copied from Blanchard. As in France the question of shape also arose, the first attempt to construct a 'fish-formed' aerostat being probably that made by Samuel Hoole in 1785. But up to 1800 and after, no design or invention of any value was forthcoming. On the other hand it may be claimed that the contribution to the solution of the many problems involved, made by Sir George Cayley over a period of years between 1816 and 1843, were as

[1] See Chapter XIII for an account of Martyn's design and other early projects

important as anything written or achieved in France, the ideas of Meusnier not excepted. For Cayley applied a mechanical mind of a high order, to an exhaustive examination of navigable balloons, which, though mainly theoretical, was far in advance of any earlier work and of much that followed it (in England) during the next fifty years or so. In view of the account of Cayley's studies given later in this book, it is not necessary to review them here.[1] Suffice it to note that Cayley was the first to insist on the importance of size or gas-containing capacity; that he was also one of the first to recognize the desirability of dividing the envelope into several compartments; that he realized the need of a 'stream-line' form, and suggested 'internal cross-bracings of wire or cord' to preserve the shape; and that he calculated the factors involved in transmitting the propelling power of an engine contained in a car (he was aware that the steam-engine could not prove wholly adequate for the purpose), to the body or hull of the aerostat. Moreover his ideas were instinct with an imaginative foresight which led him to characterize the air as 'an uninterrupted navigable ocean, which comes to every man's door', and to claim with confidence—long before the accomplished fact—that 'on a great scale, balloon floatage offers the most ready, efficient, and safe means of aerial navigation' over vast distances on the earth's surface.

Cayley's Work on Navigable Balloons, 1816–43.

But for reasons which Cayley also foresaw—the need of an efficient prime mover, and the prohibitive cost of constructing large navigable balloons—his ideas, or more broadly the general principles of the science, were not capable of that development which can come only through a combination of theory and practice. As far as is known only three dirigibles were constructed in England up to 1850, two of which, Pauly and Egg's 'Dolphin Balloon' of 1816–17, and Count Lennox's 'Eagle' of 1835, were (as already mentioned) of foreign origin. Moreover neither project materialized to the point of an actual test in the air, the 'Locomotive Balloon' constructed in London by Hugh Bell in 1850 being the only dirigible actually tried in England up to the middle of the century. It was a cylindrical balloon with conical ends, 50 feet long and 22 feet in diameter, motive power being applied by means of a screw propeller worked by hand—a method which failed to afford the requisite power, and one the inadequacy of which was finally

Later Projects.

Bell's 'Locomotive Balloon', 1850.

[1] See Ch. XIII.

demonstrated (in a paradoxical sense) by Dupuy de Lôme in 1872. No later attempt of any sort was made to construct a dirigible up to the end of the century, though numerous designs or suggestions are to be found in the pages of contemporary mechanical serials, and in the Reports of the Aeronautical Society of Great Britain from 1868 onwards. Indeed it was not until 1907 that an airship —the ill-fated 'Nulli Secundus'—was seen in England in actual flight—a fact alone sufficient to indicate the backward state of the science of airships in this country as late as the first decade of the present century.

Dirigibles in other Countries of Europe. Italy.

In Italy, the country which next to France may claim the most active share in early aeronautical history, the dirigible balloon did not call forth any specially notable projects.[1] The three brothers Agostino, Giuseppe, and Carlo Gerli, who in 1784 constructed for Paolo Andreani the first balloon to ascend in Italy, published a treatise entitled *Maniera di migliorare e dirigere i Palloni Aerei*, 1790, but they do not appear in their experiments to have made use of any propelling force, and hence their efforts to 'direct' must have been negligible. Count Zambeccari, who had made trial of oars during his exploits in England, made various experimental flights with a 'Charlo-Montgolfière' after his return to Italy, but rather by way of improving the balloon *qua* balloon, than for the set purpose of rendering it a dirigible machine.

Orlandi's Aero-Montgolfière, 1838.

At a later date Francesco Orlandi—who had assisted Zambeccari, and who played a considerable part as a pioneer of the balloon, his first ascent being made at Bologna in 1825—also constructed an 'Aero-Montgolfière', which he described in a pamphlet first published at Verona in 1825. Orlandi's invention combined a spherical gas-balloon above, with an inverted conical 'Montgolfière' below (the upper rim of the latter forming a parachute), and it was fitted with a pair of triangular wings or oars, together with a rudder. But though he appears to have made numerous ascents with the machine in Italy and in Spain, the novel ideas it embodied did not prove of any value as a contribution to the problem of dirigibility.[2] Even less practical (and constructed

[1] The writer does not pretend to have studied the development of the dirigible in Italy. The subject has been fully dealt with by Boffito (G.), *Il Volo in Italia*, 1921, ch. xx, 'Studi Italiani sulla Dirigibilità delle Macchine Aerostatiche'.

[2] Boffito, p. 267; La Vaulx, no. 23.

only on a model scale) were the designs for an 'Aereonave Rettirèmiga' or 'Nave Aerortoploa' invented by Muzio Muzzi, originally conceived in 1834, and first described, with improvements, in a pamphlet which appeared at Bologna in 1838. The balloon was of the 'hot-air' type—heated with a Davy lamp—but differed in shape from almost every earlier design in resembling a circular disk, from the axis of which Muzzi proposed to fix wing-like projections to act as paddle-wheels and to be worked by belts from the car. A triangular rudder was to be fitted from the circumference of the balloon, and (incidentally) devices were designed to record the rise and fall, as well as the direction of the wind. In a modification of his first design Muzzi altered the shape of the paddles or oars, and moved them to either side of the car, but such experiments as he made do not appear to have led him to any useful conclusions.[1] Other projects followed from time to time during the course of the century, but nothing of value was achieved until after Renard and Krebs had produced the forerunner of the modern non-rigid dirigible.

Muzzi's 'Nave Aerortoploa', 1834.

Germany.

The contributions of Germany—the first home of the rigid airship—to the solution of the problem in earlier days were also inconsiderable. The first notable and interesting project of German origin was the 'fish-shaped' military balloon—apparently inspired by the designs of Baron Scott and Pauly—constructed by Leppich in 1812 at the expense of the Russian Government. It had a rigid frame at the height of the longitudinal axis, two fins (or wings) attached to either side, and a horizontal rudder, the lower part of the keel forming the car. The full-scale dimensions of this so-called 'Leppich' airship were immense—if we may judge from the fact that the inflation is said to have occupied five days—but there is no record of its having flown.[2] A more wildly original plan—though one which reverted to an earlier notion—was that of George Rebenstein of Nuremberg in 1835. Rebenstein proposed to make use of a series of inclined planes or slats, and on this principle he based a cubical-shaped 'Montgolfière' designed to fold together when the desired height was attained and thereafter glide down to its destination.[3]

Haenlein's Airships, 1872–4.

But in 1872 Paul Haenlein (1835–1905), an engineer by profession—who had taken out an English patent in 1865 for a spindle-shaped balloon, with a rigid frame about the middle axis, and a

[1] Boffito, p. 297.
[2] Grand Carteret, p. 108; Moedebeck, p. 322.
[3] Moedebeck, p. 323.

tractor screw propelled by a gas-engine—constructed at Brunn a cylindrical balloon, which was attached to a framework by means of a longitudinal stay, and driven by a four-cylinder gas-engine working four-bladed screws (fitted to the car) at forty revolutions per minute. The rudder was attached as a projection from the stay below the tail of the envelope. Trials made in December 1872 gave a narrow margin of independent velocity and proved the navigability of the vessel, on the strength of which success Haenlein is regarded as the first to build and fly a German airship driven by a gas-engine.[1] Two years later the same inventor improved his first design, and proposed to fit several cars each containing a motor, the gas fuel to be taken from the envelope. He is believed to have been engaged on a new scheme as late as 1891, his work thus affording a link with those modern achievements in airship design which are beyond the limits of this survey.

Summarizing in a few generalizations the main trend of development—from the idea of the navigable balloon to the dirigible airship—it may be said that the first idea was almost simultaneous with the invention of the free balloon, in which it has its origin; that sails and oars, and other means of propulsion with manual power, having proved ineffectual and demonstrated the difficulties of the problem, led to countless schemes which varied greatly in conception, but which had as common ground the failure primarily due to the lack of an efficient prime mover; and that the first essential feature to become apparent was the need of an elongated or cylindrical shape, though no conclusions were arrived at as to the principles involved. Further, it may be said that the development of the airship was delayed by reason of the great expense involved in construction—a factor which taken in conjunction with size prohibited private enterprise. Finally the first limited measures of achievement were attained with dirigible balloons of a non-rigid type, propelled by means of a screw—as to the properties of which or the most efficient type, very little was known—actuated by manual effort, by steam, or by electricity, with no more than sufficient power to render them navigable in calm weather, but, nevertheless, with sufficient success to inspire those later and greater efforts witnessed in the modern types of rigid airships.

[1] *I. L. A.*, no. 693, &c. Moedebeck, p. 325. Haenlein was elected a member of the Ae.S.G.B. in Feb. 1866.

The Problem of Mechanical Flight.

Turning to survey on similar broad lines the development of mechanical flight, it will be remembered that all endeavours up to the latter half of the eighteenth century had been based on the principle of winged flight. Besnier's exploits in 1678 were repeated in 1742 by the Marquis de Bacqueville (1680–1760), who fastened primitive 'aeroplanes' to his arms and legs and essayed to fly across the Seine from the windows of his mansion—a venture in which the daring of the would-be pioneer earned the negative reward of escaping with a broken leg, incurred by falling across the deck of a barge moored in the river.[1] As the century progressed ideas on mechanical flight expanded by slow degrees and for the most part on purely theoretical lines—witness the ideas on wing resistance and stability set forth in the suggestions for a flying machine made by Emanuel Swedenborg (1688–1772) when, in early life, mechanics and inventions occupied his mind.

De Bacqueville's 'Flight', 1742.

Paucton's Treatise on the Helicopter, 1768.

A more significant contribution, albeit also confined to theory, was published in 1768 by A.-J.-P. Paucton (1736–98), a learned French mathematician, who revived Leonardo da Vinci's idea of the helicopter screw. Paucton described his *ptérophore* (as he termed it) in a treatise entitled *Théorie de la vis d'Archimède*, 1768, from which it appears that his proposed flying machine was to be fitted with two screws, one to sustain and the other to propel it.[2] The helicopter principle of the project was carried in miniature, so to speak, a step farther by Launoy, a naturalist, in collaboration with Bienvenu, a mechanician. They exhibited in 1784 before the French Academy of Sciences a device consisting of two superposed screws at the top and bottom of a rod, which was made to revolve by means of a cord (twisted round the shaft) rapidly unwound by the tension of a bow of whalebone drawn taut in the winding. The experiment was made on quite a small scale—the screws were in the form of four feathers, about a foot in diameter—but it was probably the first practical demonstration of the principles involved in the helicopter and the air-screw.[3]

Launoy and Bienvenu's Helicopter Toy, 1784.

Desforges' 'Voiture Volante', 1772.

Meanwhile in 1772 Canon Desforges, of Étampes, inspired (it is said) by reading *Peter Wilkins*, had constructed a *voiture volante* in the form of a wicker-work car fitted with wings, and surmounted—as Baron Grimm records in his contemporary account of the scheme—with a *parasol*, designed as a safeguard

[1] Lecornu, p. 33; Chanute, p. 13.

[2] Lecornu, p. 33; Chanute, p. 49; Vivien, p 39 (where the date is misprinted 1868).

[3] Chanute, p. 49.

against a rapid fall. Desforges—who is sometimes regarded as a charlatan—published a description of his 'flying carriage', which he claimed would travel seventy-five miles an hour with the wind, sixty in a calm, and twenty-five against the wind, but his manual efforts to agitate the wings had no result.[1] Doubtless following, at least in some measure, the lead of this project, J.-P. Blanchard also constructed in 1781 a *vaisseau volant*, and he likewise obtained publicity by accounts in the *Journal de Paris*. According to the set of engravings by F. N. Martinet, published in 1782, Blanchard's car was to be flown by means of four wings (worked by arms and legs), and to be steered by a rudder actuated by movements of the body of the 'pilote aérien'.[2] Blanchard also incorporated the device of a parachute to guard against a sudden fall, though his fears on the point were clearly premature, seeing that his efforts to rise were quite futile. Indeed, when offering a tribute of homage to Montgolfier as the inventor of the balloon, Blanchard admitted that the wings of his machine merely served to agitate an indocile element, with no more effect than those of a heavy ostrich.[3]

Blanchard's 'Vaisseau volant', 1781.

Meerwein's Winged Surfaces, 1781

Equally ineffective,, though on different and more scientific lines, was the attempt made about the same period by C. F. Meerwein (1737–1810), an architect of Karlsruhe, who designed a flying apparatus consisting of two light wooden frames (shaped, when outspread, like the longitudinal section of a spindle) covered with calico, hinged at the centre, and affording a slightly concave surface of 111 square feet. Meerwein was probably the first to calculate the area of wing surface necessary to support a man, and taking as a basis the weight and wing area of a wild duck, he laid down that a man with his machine weighing 200 lb. would require about 126 square feet—an estimate the approximate accuracy of which was verified by Lilienthal. But Meerwein's attempt to experiment with his machine at Giessen was not successful—indeed it would have been impossible to work the wings with anything like sufficient rapidity to raise himself from the ground.[4]

Doubtless the futility of such endeavours contrasted most unfavourably at this juncture with the success achieved by the

[1] *Journal Encyclopédique*, vol VIII, 1772, part 1, p. 119; Lecornu, p. 34; Chanute, p. 14.
[2] Bruel, nos. 7–10; *I. L. A.*, nos. 377 et seq.; Lecornu, p. 35.
[3] Lecornu, p. 39.
[4] Moedebeck, p. 278, *I L. A.*, nos. 1025–6.

aerostatic method of aerial flight, and tended to discourage, though not wholly to suppress, further attempts. The winged machine of Jakob Degen (1756–1846), a clockmaker of Vienna, suffered a similar fate, for though he was reported to have achieved some success, Degen—following in a modified form the example of Blanchard—raised himself and his wings in the air beneath a small balloon. His experiments were carried on over some three years between 1808 and 1812, and attracted widespread attention; but though he exercised considerable ingenuity in the construction of his wings—made of silk stretched over an oblong conical framework, supported by king-post bracing, and affording a supporting surface of 130 square feet—his endeavours were fruitless.[1]

Degen's Winged Flying Machine, 1809–12.

The Main Cause of Failure.

Many other ventures of a similar character, with almost countless variations in the form and construction both of wings and the method of actuating them, were forthcoming during the nineteenth century. But as Chanute pointed out in his careful historical analysis of the evolution of flying machines, the reasons for their inevitable failure—due essentially to the inadequacy of muscular power—were fully demonstrated in the two cases of the Marquis de Bacqueville and Blanchard. For either the wings (as in the first case) were small enough to be flapped with some rapidity, but too small to afford sufficient supporting surface, or they were large enough (as in the second case) to approximately answer the latter purpose but too large to be moved at any adequate speed.[2]

Cayley on Mechanical Flight, 1809–10.

It is because Sir George Cayley wholly discarded the ornithological or muscular wing-flapping idea, and regarded flight from the purely mechanical aspect, that a new era in the progress of aviation may be said to have opened with the publication in 1809–10 of his essays on aerial navigation.

In view of the account of Cayley's aerostatic experiments and his general ideas on mechanical flight given in a later chapter, it is unnecessary to discuss them here.[3] Suffice it to say that while the older notions survived both in England and abroad, Cayley boldly opened up a new view which continued to gather force as the nineteenth century progressed, and which led ultimately to the development of the aeroplane. His earliest experiments were made in 1796 with what he called a Chinese top, a helicopter toy identical (though he did not mention the fact)

[1] La Landelle, p. 223; Chanute, p. 17, Moedebeck, p. 281; Bruel, nos. 189–91.
[2] Chanute, p. 14. [3] Ch. XV.

with that exhibited by Launoy and Bienvenu in 1784.[1] Combined with careful observations on bird-flight—observations which revealed a breaking-away from the obsession as to the importance of the downward beat of the wing—Cayley's experiments led him in 1809 to propound the 'whole problem' of mechanical flight as contained in the scientific formula, 'To make a surface support a given weight by the application of power to the resistance of air'. Moreover, he sought to confirm his theoretical reasoning by trials with a 'gliding' machine, as a result of which he expressed perfect confidence in the practicability of constructing a machine in which both passengers and goods could be transported 'more securely by air than by water, and with a velocity of from 20 to 100 miles per hour'. The great obstacle to flight in his day—the *sine qua non*, as he said, of ultimate success—was the lack of an efficient prime mover, the essential importance of which impelled him (in view of the impracticability of using steam) to consider the possibilities of the gas-engine. There can be little doubt that Cayley's exposition of the principles of mechanical flight influenced the ambitious project of W. S. Henson, who designed in 1842 the first 'monoplane' with rigid wings to be propelled by a steam-engine driving two propellers, and controlled by a triangular tail and a rudder. It was never constructed on full scale, but the numerous experiments with models carried out by Henson in conjunction with John Stringfellow, form (as related hereafter) an interesting and important incident in the modern evolution of aeroplane flight.[2] Nor is the value of Stringfellow's work diminished by the fact that the only practical result was limited to his significant and historic achievement of 1848, when, for the first time, he constructed a power-driven model machine which flew a short distance.

Henson's 'Ariel Carriage', 1842.

Stringfellow's Flying Model, 1848.

Seeing that Cayley's first experiments with a helicopter toy were made in 1796, that Henson's 'Ariel' scheme was in full swing in 1843, and that Stringfellow lived to carry out experiments with a model 'triplane' as late as 1868, the work of these three pioneers covers the long period of nearly seventy years. Regarded as a whole, their endeavours afford an epitome of the most important work done in England during that time. Moreover, as a record of connected stages in the evolution of flight it is, in some respects,

[1] Cf. the illustration in Chanute, p. 49, and that in *Aeronaut. Classics*, no. 1, p. 12.
[2] Ch. XV.

more important than any similar developments in France. For that reason, before returning to French endeavours it may best serve the purposes of this survey to refer briefly to a few contemporary and later pioneers in England down to, say, the last two decades of the nineteenth century, sufficient to convey an adequate outline of the growth of ideas, prior to the period in which the experiments of the great 'gliders'—Lilienthal, Pilcher, and Chanute—served as a splendid prologue to usher in the era of achievement.

Walker's *Art of Flying*, 1810.

As in other fields of science—the simultaneous but independent exposition of the theory of evolution by Darwin and Spencer is a case in point—so in the region of aeronautics, Cayley and Walker arrived, almost at the same moment, at similar conclusions as to the true nature of mechanical flight. In 1800 Thomas Walker, a portrait painter of Hull, published his *Treatise upon the Art of Flying by Mechanical Means*—the first separate treatise on the subject published in this country—in which he maintained that 'the art of flying is as truly *mechanical* as the art of rowing a boat'. He argued further that the two requisites of flight are 'first, *expansion of flat passive surfaces large enough* to reduce the force of gravity so as to *float* the machine upon the air'; and 'second, *strength enough* to strike the wings with a sufficient force to complete the buoyancy, and give a projectile motion to the machine'. These ideas afford to Walker a kinship with Cayley, though the latter was far in advance in experimental knowledge and in his capacity for scientific exposition—facts clearly demonstrated by Walker's adherence to propulsion by means of wings, and his entirely erroneous belief that man's muscular strength would afford sufficient power.

Wenham's *Aerial of Locomotion*, 1866.

During the fifty years that followed the publication of the writings of Cayley and Walker, there was a dearth of endeavour in mechanical flight, save for the notable work of Henson and Stringfellow. But the growing attention paid to the purely scientific or aerodynamic aspects of bird-flight led up to F. H. Wenham's classic paper on *Aerial Locomotion*, originally made public—though written seven years earlier—through the agency of the newly formed 'Aeronautical Society of Great Britain', at their first general meeting in 1866. Wenham's ideas and the designs he subsequently conceived were based on careful observations of bird-flight, and his contribution to the problems involved

carried the earlier work of Cayley and Stringfellow a stage further on the road to achievement. His own work was essentially original, and apart from the great influence it had on the trend of investigations during the remaining years of the century, is important for its enunciation of the doctrine that the effective supporting area of an inclined plane propelled through the air is limited to a narrow front portion, and for its confirmation of the fact that flight did not require the great power that was commonly believed to be necessary. It is true there still remained an immense amount of work to be done before bird-flight was essentially understood, or the true lessons to be learned therefrom could be applied to mechanical flight—work carried out with scientific skill and important results by Count d'Esterno, E. J. Marey, and L. P. Mouillard, in France, and in this country by J. Bell Pettigrew (with much more questionable success) and G. Hartwig.[1] But Wenham's ideas, as aforesaid, gave a new and illuminating impulse to the science of mechanical flight, though he realized that much would have to be learned- by practical trials—about stability, and a light engine of adequate power—on the lines of the gas-engine he designed—would have to be invented.

The Balloon as an Obstacle to Flight in France.

Reverting to the progress of ideas in France from the early years of the nineteenth century, it is noticeable that in the country of its invention the balloon appears to have almost entirely displaced, for a time, the idea of mechanical flight as a method of aerial navigation. Certainly no work—theoretical, practical, or designed—emanating from France, or indeed any other country, can be compared in importance or extent with that of Cayley, Henson, and Stringfellow in England. Indeed, it was not until towards the middle of the century that a revival of aviation became apparent. Amongst the first to devote serious attention to it was Vicomte Gustave de Ponton d'Amécourt, who in 1863 renewed experiments with the helicopter in a modified form. But as Ponton d'Amécourt was subsequently associated with La Landelle and Nadar, whose combined efforts covered many years, it will be more convenient to deal first with a few other investigations of the same period whose work was more detached.

[1] Esterno (Count d'), *Du Vol des Oiseaux*, 1864. Professor E. J. Marey published several works on bird-flight and introduced the chronological and photographic methods of observation. Mouillard's most important work—the result of thirty years' observations—was *L'Empire de l'Air*, 1881. Pettigrew's work is chiefly contained in his *Animal Locomotion*, first published in 1874. Hartwig's *Aerial World* appeared in 1873–4.

Among the most notable of these was Jean-Marie Le Bris (1808–72), a sea captain of Brittany and a man of remarkable energy and determination, endowed, moreover, with a full measure of the courage and daring of his race. Impressed during voyages to Cape Horn and elsewhere with the remarkable faculty for soaring flight possessed by the albatross, he was fired to imitate their powers by the construction of an artificial bird. La Landelle gives a picturesque account of Le Bris's machine—the body in the form of a *sabot*, with wings having a total span of 23 feet and a surface of about 220 square feet, the inclination of which was to some extent controlled by means of pulleys and cords actuated by levers. With this and other machines Le Bris carried out many experiments over a period of several years, near Douarnenez, not far from Brest. On one remarkable occasion, probably in 1857, he placed his artificial bird on a horse-drawn cart, and on being thus carried against the wind his machine—attached by a rope in the manner of a kite—was lifted clear of the vehicle, above which it is said to have risen to a height of 300 feet. Encouraged by this success he made further trials, in one of which he had a bad fall which smashed the machine and broke Le Bris's leg. After a lapse of about twelve years he renewed his experiments in 1868, though without repeating his former success. Indeed, it was doubtless his sailor's knowledge of winds and sails, coupled with intrepidity and resolution, which enabled him to achieve as much as he did, and his work—which earned a tribute of appreciation from Chanute—is deserving of remembrance amongst those greater pioneers who risked, indeed some of whom gave their lives, in attempting free flight.[1]

Le Bris's 'Gliding' Experiments, 1854–68.

Endowed as a kindred spirit with the sea sense, though destined by reason of physical ill-health to forgo a naval career, was Alphonse Pénaud (1850–80). Debarred from entering the French Navy, Pénaud was drawn to aeronautics by reading an article hostile to the doctrine of flight. He set to work to think out the problem for himself, and constructed various small models on lines which involved scientific considerations that had been ignored by Le Bris, particularly the essential question of longitudinal stability—a difficulty the importance of which had been previously pointed out by Captain Béléguic, a French naval officer. In 1870 Pénaud produced a model helicopter in which a strand of twisted rubber replaced—with better effect—the

Alphonse Pénaud's Flying Models, 1870–6.

[1] La Landelle, p. 206; Chanute, p. 104, &c. A photograph of the second machine used by Le Bris in 1868 is preserved in the Musée Carnavalet, Paris.

whalebone or steel bow used by Cayley. The year following he conducted more useful experiments with what he termed a *planophore*, or small model aeroplane, in which he again used twisted rubber as a motive power, and which he designed on principles intended to secure automatic equilibrium. This he successfully and significantly achieved by arranging the centre of gravity slightly in advance of the centre of the sustaining surface, effected by means of a rod projecting in front of the wings. The ends of the two fixed wings were turned up so as to secure lateral stability by a dihedral angle, while longitudinal stability was provided for by a smaller pair of rudders behind, set so as to form a longitudinal dihedral angle with the main supporting surfaces. Pénaud exhibited his apparatus in August 1871, at a meeting of the Société de Navigation Aérienne in the garden of the Tuileries, when it flew in a horizontal position for twenty seconds, and after completing a circuit fell near the spot from which it had been started. In 1876 Pénaud, in conjunction with Paul Gauchot, designed (with careful attention to details) a full-scale machine, which he calculated would require an engine of twenty to thirty horse-power, and the stability of which he conceived would be attained by the use of two horizontal rudders in the tail. But lack of funds and the difficulties inherent in this project—which according to La Landelle bore the stamp of genius—proved obstacles Pénaud was not fitted to overcome. His death in 1880, at the early age of thirty, cut short a career which gave promise, despite the disabilities of physical infirmity, of great achievements in aeronautics of a truly scientific character.[1] Pénaud's chief contribution to the elucidation of the problem of flight lay in his appreciation of the importance of the factor of stability, and his later endeavours went a long way beyond his early efforts with a helicopter. But the latter device continued to exert over experimentalists in aeronautics something akin to fascination—the fascination, probably, of achieving the seemingly impossible. It has, however, been pointed out that from Paucton downwards most of the workers in this field failed to appreciate the inefficiency of the helicopter principle as applied to aerial flight—inasmuch as the helicopter machine requires as much power for the sustentation of its own weight in the air as the aeroplane for support in and propulsion through the air.[2] This misconception vitiated countless designs emanating from the Continent, Great Britain, and the

Various Experiments with Helicopters, 1855–78.

[1] La Landelle, p. 215; Chanute, p. 117, &c.; Popper-Lynkeus (J.), *Der Maschinen- und Vogelflug*, Berlin, 1911.

[2] Vivian, p. 86.

United States during the nineteenth century—the experimental model (actuated with gas-charged steam) of W. H. Phillips in 1842, the triple steam-driven apparatus of Cossus in 1845, the duplex machine of H. Bright in 1859, the more elaborate multiple helicopter (worked by compressed air) of P. Castel in 1878, or the lighter model of Enrico Forlanini, an Italian officer, in 1877, to mention only a few.[1] Indeed, the helicopter as a method of flight in the sense of aerial navigation is of itself useless, though with the development of power it may ultimately be combined with the aeroplane as an efficient adjunct.

Ponton d'Amécourt's Helicopter, 1863.

But meanwhile the belief that the true principle of mechanical flight was to be found in the inclined plane driven through the air at high speed continued to gain ground in France, as against the method of the helicopter or the flapping wing. Nevertheless—to return to Ponton d'Amécourt—it was experiments with the former that gave rise to the work of several distinguished French workers in the field of aeronautics, and led to a strong movement in favour of the 'plus lourd que l'air' method of flight. For when in 1863 Ponton d'Amécourt constructed an experimental steam-driven helicopter[2]—to the principle of which his attention had been drawn ten years earlier—the endeavour called forth the support of Gabriel de La Landelle (1812–86), who in turn enlisted the interest of Félix Tournachon (1820–1910), better known as Nadar. As a result Nadar, a man of immense energy and great ability, threw himself wholeheartedly into the cause of 'heavier-than-air' flight. In or about 1862 he started, in conjunction with Ponton d'Amécourt and La Landelle, the 'Société d'Autolocomotion Aérienne', the name of which was soon after changed to 'La Société d'Encouragement pour la Locomotion Aérienne au moyen d'Appareils plus lourds que l'Air', and again in 1864 to 'Société d'Aviation'—the introduction of the latter word being attributed to La Landelle. Realizing that large funds would be necessary for experimental work, he constructed the huge balloon, 'Le Géant', as a means of raising them, thus utilizing the 'false principle of buoyancy'—as the Duke of Argyll termed aerostation—to forward the cause of mechanical flight. It is unnecessary to

La Landelle and Nadar advocate 'Heavier-than-air' Flight, 1863.

[1] Chanute (p. 51) regarded the model of W. H. Phillips (see *Report of Aeronaut. Soc. Exhibition*, 1868, p. 10) as the 'first machine which has risen into the air by steam-power'. Henry Bright's machine (see *Aeronaut. Soc. Report*, 1867, p. 6) was accepted at the Museum of Patents in 1861 as 'the first thing which has overcome gravity . . by mechanical power contained within itself'. For Cossus, Castel, and Forlanini see Chanute, pp. 51, 61, and 62.

[2] This model of 1863 is now in the Aeronautical Museum at Chalais-Meudon.

relate the adventures and misadventures which befell his enterprise. It is sufficient to note that the movement gave a marked impetus to the general interest in mechanical flying machines, and to the scientific study of the problems connected therewith. Ponton d'Amécourt himself became president in 1865 of the 'Société Aérostatique et Météorologique de France'—apparently a resuscitation of an earlier society of the same name, founded by Dupuis-Delcourt in 1852—which changed its title in 1869 to 'La Société Aéronautique et Météorologique de France', and through which the existing 'Société de Navigation Aérienne' can trace its origin in 1872. Doubtless these activities encouraged, if they did not inspire, the first efforts—on the ornithopter principle—of Clement Ader in 1872, which subsequently resulted in his construction of a steam-driven aeroplane in 1886, and his more important experiments of 1890 and 1897, the latter carrying the story of mechanical flight in France to the very threshold of success.

With the name of Ader this survey of the development of mechanical flight in France may fitly be brought to a conclusion, at the period—namely about 1880—when the efforts of Thomas Moy and others had carried development in England to an analogous stage. For the position as to mechanical flight—the ultimate accomplishment of which seemed now assured—was at this time very similar in France, England, Germany, and elsewhere. The basic principles of the aeroplane were sufficiently understood, but the aerodynamic factors which governed the stability of any machine that might be designed were largely unknown. Moreover, the power to drive it at an adequate speed through the air was still to be found. The former difficulties were in great measure made clear—thus marking the penultimate step to their overthrow—by the 'gliding' experiments of Lilienthal, Pilcher, Chanute, and others, while the power was supplied by the introduction of the internal combustion engine as invented by Gustav Daimler about 1886, and its subsequent development by French engineers. It only remained for the great pioneer aviators—the Wrights, Ferber, Archdeacon, Santos-Dumont, and others—to test the combined application of the newly discovered factors, and mechanical flight quickly became as assured a method of aerial navigation as the airship had become a few years earlier.[1]

[1] As previously recorded the first successful non-rigid, 'La France', was constructed and flown in 1884, while Zeppelin's first rigid airship was tested in 1900. The Wright brothers achieved their earliest (short) flights in 1903–4.

CHAPTER I

LEGEND, APOCRYPHAL FLIGHT, AND ROMANCE

The Flying Legend of King Bladud, 852 B. C.

THE beginnings of aeronautical history in Great Britain, as in other countries of the civilized world, open with a legend of winged flight—the legend of the attempt to fly made by Bladud, the mythical tenth King of Britain, which resulted in his death (as it is said) in 852 B. C.[1] The story was first recorded by Geoffrey of Monmouth (1100–54), in his great work the *Historia Regum Britanniae*, which, though written in or about the year 1147, and thereafter widely circulated in manuscript copies, was not printed until 1508.[2] The sources of Geoffrey's Chronicle and his originality as an inventor of the tales he narrates, have been the subject of much learned controversy, with which, however, the present work has no concern, it being sufficient to remember that Geoffrey 'was no mere monkish student eager to swallow wondrous stories, but a shrewd scholar equipped with all the learning of his age'.[3] In a general way the legend runs that King Bladud, the reputed founder of Bath and the father of the more widely remembered but equally mythical King Lear, not only practised the art of necromancy or magic, but taught it throughout his kingdom. It is recorded to have been in an endeavour to maintain his reputation for the performance of marvellous tricks, that he made wings of feathers with which to attempt flight. The story as told by Geoffrey in the *Historia Britonum*, was first given in English in the 1516 edition of Fabyan's Chronicle, in the quaint language of which it may be here quoted. 'This Bladud', writes Fabyan, 'as affermeth y foresayd Auctor Gaufride, taught this lore of

[1] See Professor Sayce's paper on King Bladud in *Y Cymmrodor*, vol. x, 1890, pp. 207–21. The story of Bladud is fully dealt with in *The British King who tried to Fly*, by H. C. Levis, privately printed, 1919.

[2] Geoffrey of Monmouth. Historia Britonum, by Ascensius, Paris, 1508, Liber 1, fos. xii and xiii. The story of the flight appeared subsequently in the Chronicles of Hardyng, 1543, Bale, 1548, Stow, 1567, Grafton, 1569, &c. It is also related in *A Memoriall of all the English Monarchs*, by John Taylor, the Water Poet, 1622. See Fig. 1.

[3] *D. N. B.*, vol. xxi, 1890.

Negromancy through his Realme. And fynally toke in it suche pryde & presumpcion that he toke upon hym to flie into y ayer but he fyll upon the temple of his god Appolyn [in the City of Trinovantum, i. e. London], and theron was all to torne when he had ruled Brytayne by the space of xx yeres leaynge after hym a sone named Leyr.' A more freely imaginative and interesting conception of Bladud's disastrous attempt to fly is given in the *Mirror for Magistrates*, 1559, a 'Chronicle', partly in verse and partly in prose, where the king is made to recite 'howe he practizinge by curious arts to flye, fell and brake his necke'. Through the poet's imagination Bladud, having related his journey to Athens, the learning he acquired there, and the measures he took on his return for the good government of his kingdom, points a warning to others (in accordance with the scheme of the book) in the fatal outcome of his vain and foolish aspiration to achieve fame by flying:

The Poetical Version in the *Mirror for Magistrates*, 1559.

Were not it strange, thinke you a King to flie,
To Play the tombler, or some jugling cast?
To dresse himselfe in plumes, as erst did I,
And vnder armes to knit on wings full fast?
A sport you thinke that might the wise agast,
  But Magicke arte had taught me points of skill,
  Which in the end did proue my future ill.

I deckt my corpse with plumes (I say) and wings,
And had them set, thou seest, in skilfull wise,
With many feats, fine poyseing equall things,
To aide my selfe in flight to fall or rise,
Few men did euer vse like enterprise
  Gainst store of wind, by practise rise I could,
  And turne and winde at last which way I would.

But ere the perfect skill I learned had,
(And yet me thought I could do passing well)
My subjects hearts with pleasant toyes to glad,
From Temples top, where did Apollo dwell,
I sayd to flie, but on the Church I fell,
  And in the fall I lost my life withal.
  This was my race, this was my fatall fall.[1]

[1] The first part of the *Mirrour for Magistrates*, containing the 'Falles of the First Unfortunate Princes of this lande', edition of 1574, fos. 40 et seq. The *Mirrour* had a considerable vogue, the above quotation being from the final revised edition of 1610.

Bladud reign'd 20. 863.

This Bladud [illegible] *beene a student in Athens, from thence he brought many learned men, he built Stamford, a Colledge, I thinke, the first in England, striuing to play the Fowle or the Foole, he brake his necke on the temple of Apollo in Troynouant.*

BAthe was by *Bladud* to perfection brought,
By Necromanticke Arts, to flye he sought:
As from a Towre he thought to scale the sky,
He brake his necke, because he soar'd too high.

FIG 1 BLADUD THE FLYING KING OF BRITAIN, 863 B C
From Taylor's *Memoriall of English Monarchs*, 1622

And first of all by the figuration of Art it selfe: There may bee made instruments of Nauigation without men to rowe in them: as huge Shippes to brooke the Sea, onely with one man to steere them, which shal saile farre more swiftly then if they were full of men. And Chariots that shall mooue with an vnspeakeable force, without any liuing creature to stirre them: such as the crooked Chariots are supposed to haue beene, wherein in olde time they vsed to fight, yea instruments to flie withall, so that one sitting in the middle of the Instrument, and turning about an Engine, by which the winges being artificially composed may beate the ayre after the maner of a flying bird. Besides, there

Moreouer instruments may be made wherewith men may walke in the bottome of the Sea or Riuers without bodily danger, which *Alexander* the great vsed, to the ende he might beholde the secrets of the seas, as the Ethick Philosopher reporteth: and these haue bin made not onely in times past, but euen in our dayes. And it is certaine that there is an instrument to flie with, which I neuer sawe, nor know any mā that hath seene it, but I full wel know by name the learned man that inuented the same. In

FIG 2 ROGER BACON ON MECHANICAL FLIGHT, *ca.* 1250.
From *The Mirror of Alchymy*, 1597.

In the edition of 1587 John Higgins—the author of this section of the *Mirror*—further points the moral of the story:

'L'Envoi'.

Who so that takes in hand the aire to scale,
As *Bladud* here did take on him to flie:
Or *Dedals* sonne (as Poets tell the tale)
Yong Icarus, that flew (they say) so hie;
Or else as *Simon Magus* flew perdy:
  Though nere so well his plumes and winges hee decke,
  By sea h'is droun'd, by land hee breakes his necke.

On ground is surest place for men to goe,
But yet take heede and let your ground bee good:
The surest footing is perdy beloe;
Who styes the aire I count his dealing wood,
The slender buildings hauty, feoble stoode,
  On high the tempests haue much powre to wrecke:
  Then best to bide beneath, and surest for the necke.

Oliver of Malmesbury's Attempt to Fly, *ca.* 1020

Hardly less legendary, but more often quoted, is the attempt to achieve aerial flight recorded as having been made by Oliver of Malmesbury (otherwise known as Eilmer or Elmer) early in the eleventh century. Elmer, a monk whose reputed learning was mainly concerned with astrology and mechanics, is best known in connexion with the story of his apostrophe to the comet of 1066, originally recounted in the twelfth-century chronicle of William of Malmesbury.[1] As briefly related by Milton in his *History of Britain*, 1670, the story of Oliver's attempted flight is that 'he in his youth strangely aspiring, had made and fitted Wings to his Hands and Feet; with these on the top of a Tower, spread out to gather air, he flew more than a Furlong; but the wind being too high, came fluttering down, to the maiming of all his Limbs; yet so conceited of his Art, that he attributed the cause of his fall to the want of a Tail, as Birds have, which he forgot to make to his hinder parts'. Beyond the permanent lameness which resulted from the fall nothing further is known of Elmer's flight, and it was only the 'strange-ness thereof' that afforded Milton the ground on which he deemed the story,

[1] William of Malmesbury, *Gesta Regum Anglorum* [completed in 1125], lib. ii, c. 225 (Rolls Series). Bale in his *Catalogue* attributed to Oliver three works on astrology and mathematics which are not extant.

otherwise too light for inclusion in a serious history, worthy of narration.[1]

John Damian, Abbot of Tungland, 1507.

Passing over (for the moment) the speculations of Roger Bacon, the legend of King Bladud is recalled in the story of another apocryphal flight attempted by John Damian from the top of Stirling Castle in the autumn of 1507. Damian, an Italian by birth, came to Edinburgh from France in 1501, and being apparently a man of pleasant appearance, insinuating manners, and great ingenuity, became a favourite of King James IV, residing at the Scottish Court in the capacity of physician to the king's household. His specious manners so far gained the confidence of the king—with whom he was often engaged in card-playing—as to induce his royal patron to find considerable sums of money for the purpose of alchemistic experiments in converting base metals into pure gold. Not content with the part he played as a quack doctor, alchemist, and boon companion to the king, he aspired also—as the Treasurer's Accounts testify—to that of stage-manager, mining engineer, and aeronaut, thus affording an example for ballooning adventurers of later times in the predatory tricks practised on a gullible public. Moreover, though Damian is not known to have been in any way connected with ecclesiastical concerns prior to his appearance in Scotland, he so arranged matters that in 1504 the king conferred on him the abbacy of Tungland—a circumstance which excited the ire and the envy of William Dunbar (*ca.* 1465–1530), the Scottish poet, who was at this time looking to the king for some such ecclesiastical preferment.[2] But though Damian was clearly an adventurer, it is reasonable to imagine that the aeronautical exploit in which he risked his reputation, and indeed his life, must have involved some contrivance in the practicability of which he himself believed—a point, however, on which there is no information.

His Attempted Flight from Stirling Castle.

The venture, as undertaken in September or October 1507—when an embassy having been recently sent to France, Damian averred he could overtake it by flying—is related by John Lesley (1527–96), Bishop of Ross, in the original Scottish version of his

[1] Milton's *History of Britain*, 1670; see Pickering's edition of the Prose Works, 1851, vol. v, p. 293. Tissandier (vol. i, p. xiii) concludes a paragraph on the flight of 'Olivier de Malesbury' by recording his death at Malmesbury in 1060. But there is no ground for supposing—as the wording suggests—that his death, which took place at a good age not before 1066, in any way resulted from his fall The *Ency. Brit.*, 11th edition, in quoting from Bishop Wilkins, adds (without authority) that the flight took place in Spain.

[2] *D. N. B.*, vol. xvi, 1888, p. 150.

History of Scotland, 1578. 'This Abbot [of Tungland]', so runs the story,

'tuik in hand to flie with wings, and to be in Fraunce befoir the saidis Ambassadouris: And to that effect he causet mak ane pair of wingis of fedderis, quhilkis beand fessinet apoun him, he flew of the Castell wall of Striveling, but shortlie he fell to the ground and brak his thee bane; bot the wyt thereof he asscryvit to that thair was sum hen fedderis in the wingis, quhilk yarnit and covet the mydding [midden] and not the skyis'.[1]

Leslie concludes his narration with the remark that in this adventure Damian was endeavouring to outdo King Bladud.

In jocularly ascribing his fall to the fact that the hens' feathers, of which his wings were partly made, showed a natural affinity to return to the dunghill instead of maintaining flight in the air, and in following up his failure by subsequently leaving the country for a time, Damian seems to have adopted a course consistent with his character. In September of the year following he obtained a licence to pass out of the realm without prejudice to his rights in the abbey. Returning some five years later, his successful and adventurous career as Abbot of Tungland was brought to a sudden end by the death of James IV on Flodden Field, soon after which event Damian left Scotland for good.

William Dunbar's Satires on Damian, 1507.

The two satires which Dunbar directed against the Abbot of Tungland—one written on hearing of the rumoured attempt at flight, the other after the attempt had failed and become the subject of ridicule—throw no light on the character of Damian's exploit. They are both cast in the form of a dream, in the second and longer of which—a vituperative poem entitled 'The Fenzeit [frenzied] Freir of Tungland'—the poet indulges an ironic fancy in depicting the object of his antipathy as an adventurous monster, who, having invented the art of flying, essays to journey to Turkey. Successful at first, the flight is quickly brought to a ludicrous end through the relentless attacks of the birds of the air, to avoid the fierceness of which the flying monster is fain to throw away his wings and hide himself in the mire into which he falls. The clatter made by the enraged birds awakens the poet from his vision, and the poem concludes with curses which, hurled on the flying friar as the cause of the imagined disturbance, were intended

[1] Lesley, or Leslie (J.), *History of Scotland* (written 1568–70), Bannatyne Club edition, Edinburgh, 1830, p. 76.

to fall on Dunbar's enemy and rival, the spurious Abbot of Tungland.[1]

Bishop Godwin's Flying Romance, 1638.

Though there are very few, if any, extant English references to flight during the hundred years or more following the 'strange adventure' of Damian, the seventeenth century gave birth to several imaginative works of aeronautical interest. A purely fanciful conception was drawn by Francis Godwin (1562–1633), Bishop of Hereford, in his romance entitled *The Man in the Moone, or a Discourse of a Voyage thither by Domingo Gonsales the Speedy Messenger*, first published posthumously in 1638.[2] Though of no special merit as literature the story had a considerable vogue and may still be read with amusement; it was several times reprinted, and translated both into French and Dutch.[3] It relates—to quote the title adopted for the version reprinted in the *English Acquisitions in Guinea and the East Indies*, 1728—the 'Admirable Voyage of Domingo Gonsales, the little Spaniard, to the World in the Moon, by the help of several Gansas or Large Geese'.[4] Gonsales having been abandoned during a sea voyage (by reason of sickness) on the then uninhabited Island of St. Helena, occupies himself by training a number of wild swans to obey his call, and little by little to fly with small burdens. Having conceived the idea of harnessing several birds together, he devised mechanism whereby he may overcome the difficulty of distributing the weight equally at the start of the flight. 'I fastened', says the fictitious adventurer, 'about every one of my Gansas a little pulley of Corke, and putting a string through it of meetly length, I fastened the one end thereof unto a blocke almost of eight Pound weight, unto the other end of the string I tied a poyse, weighing some two Pound'—an ingenious if impossible method which is depicted in the engraving (Fig. 3) contained in the first edition.[5] With a team of seven birds Gonsales

[1] The foregoing account of Damian is taken from the edition of William Dunbar's *Poems*, edited, with introductions and notes, by J. Schipper, Vienna, 1892.

[2] Cf. Raleigh (W.), *The English Novel*, 1901, p. 136, where the book is said to have been written (at Oxford) before 1603, and to have drawn its inspiration from Lucian It was reprinted in 1657, 1768, &c

[3] The first French translation (that referred to by E. A Poe in a note to his 'moon-hoax' story of 'Hans Pfaall'), appeared in 1648 Tissandier (vol. i, p xv), unaware of the English authorship, erroneously refers to the French translation as made from the Spanish of Gonsales. Grand-Carteret (p. 34) likewise ignores the English author.

[4] [Burton (R., i. e. Nathaniel Crouch)], *A View of the English Acquisitions in Guinea*, &c., by R B , 1728, pp 63–104. See Bibliography.

[5] The idea of using large birds in drawing an aerial conveyance dates back to remote ages. It was revived at a much later period, both in England and abroad, as a practical project (see Ch. XIII, p. 293).

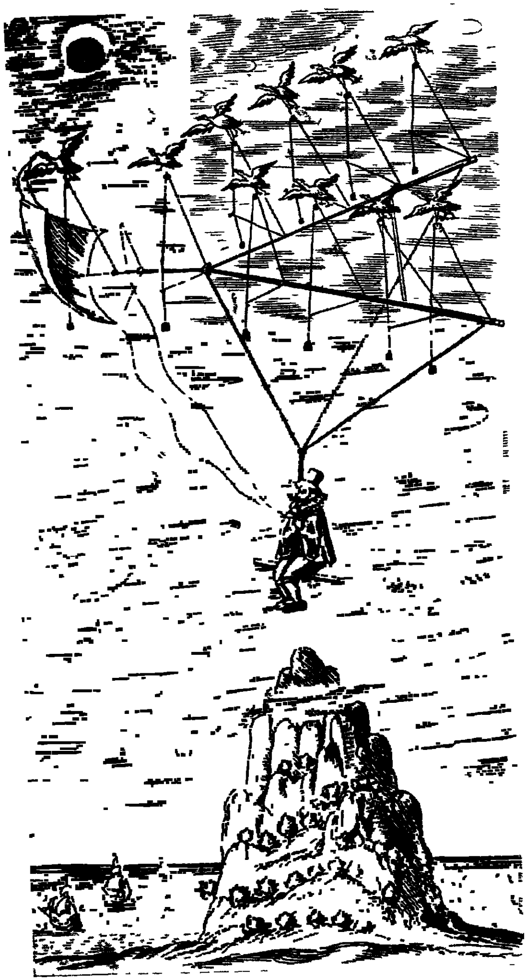

FIG 3 THE AERIAL VOYAGE OF DOMINGO GONSALES
From Godwin's *Man in the Moone*, 1638

FIG 4 A GAWRY, OR FLYING WOMAN
From Paltock's *Peter Wilkins*, 1751

experiments on a lamb, whose happiness he much envies as being 'the first living creature to take possession of such a device', the comment having a curiously prophetic sound, in that a sheep actually was one of the first animals to ascend into the air.[1] By increasing the number of birds to about twenty-five Gonsales is himself carried aloft to his great satisfaction, 'for I hold it farre more honour', says he, 'to have been the first flying man, than to bee another Neptune that first adventured to sayle upon the Sea'.[2] On his return voyage to Spain Gonsales is saved from shipwreck by his 'gansas', who subsequently fly away with him to the moon—a journey which lasts eleven days and is described at some length. He subsequently learns that the birds he has trained are not really denizens of St. Helena, but of the moon, and hence their flight thither is but a natural return from a migratory visit. Perhaps the most interesting approach to scientific speculation in this fanciful voyage is suggested in the astonishment of the traveller on finding that at a great height—when beyond the magnetic attraction of the earth—the birds are in equilibrium, and can either remain stationary or move rapidly in the air, as fish do in the water. For the rest the 'flying' character of the story is maintained in the description of the 'fans of feathers' which the inhabitants of the moon use for the purpose of flight.[3]

Godwin's name is now seldom remembered save by scholars who may consult his learned work *De Praesulibus Angliae Commentarius*, while his romance has sunk into comparative obscurity. But his name deserves to be kept in remembrance in aeronautical history. For though flight had been an aspiration and an object of achievement long before Godwin's time, the idea that 'the first flying man' would be greatly deserving of honour, finds its earliest expression in the sentiments above quoted. Moreover, that ingenious pioneer of flight, Domingo Gonsales, though an imaginary creation, is inspired with an admirable spirit of enthusiasm for aerial adventure of a kind that has since inspired a countless succession of real pioneers in aeronautical endeavour. To suggest

[1] As is well known, a sheep, a cock, and a duck were enclosed in a basket beneath the hot-air balloon sent up by the Montgolfiers from Versailles on Sept. 19, 1783. (Cf. Fig 62.)

[2] The parallel suggested by Godwin—and used by others on the invention of the balloon—was doubtless inspired by Horace, *Odes*, I. iii, lines 9–12, 'qui fragilem truci commisit pelago ratem primus'.

[3] The idea of a flight to the moon—and the sun—afforded to Cyrano de Bergerac (as to others) the subject of his *Histoire Comique des États et Empires de la Lune*, &c., 1657–62, into which Gonsales is introduced. English translations appeared in 1659, 1687, and 1753.

that Godwin's book created that spirit would be to press the point unduly—the *motif* of a first success has ever been a strong one, and one which usually predicates the impulse of enthusiasm. In a literary sense it is evident that *The Man in the Moone* had considerable influence—it is said that Swift derived from it the idea of the 'flying island' in *Gulliver's Travels*, 1727, while several features of Godwin's romance were reproduced in *A Voyage to Cacklogallinia*, 1727, which recounts adventures among a race of 'bird-men' and narrates a voyage to the moon.[1]

Addison's Satire on Flight, 1713.

Bearing in mind that during the seventeenth century flight was not merely a subject for the imagination—as the chapter following will disclose—it may be convenient to deal with the imaginative aspect down to the invention of the balloon. Within that category, though suggested by the scientific speculations of 'the famous Bishop Wilkins', is the letter of 'Daedalus' which appears in one of the papers contributed by Addison to *The Guardian*, 1713. Clearly 'Mr. Spectator' had no faith in the 'art of flying', and the imaginary epistle from 'an artist who is now taken up with this invention', is made the medium for satire, inimitably gentle and good-humoured, but doubtless in this as in other matters not the less effective thereby.

'Knowing [so runs the letter] that you are a great encourager of ingenuity, I think fit to acquaint you, that I have made a considerable progress in the art of flying. I flutter about my room two or three hours in a morning, and when my wings are on, can go above an hundred yards at a hop, step, and jump. I can fly already as well as a Turkey-cock, and improve every day. If I proceed as I have begun, I intend to give the world a proof of my proficiency, in this art. Upon the next public thanksgiving-day, it is my design to sit astride the dragon upon Bow steeple, from whence after the first discharge of the Tower guns, I intend to mount into the air, fly over Fleet-street, and pitch upon the May-pole in the Strand. From thence, by a gradual descent, I shall make the best of my way to St. James's Park, and light upon the ground near Rosamond's pond. This, I doubt not, will convince the world, that I am no pretender; but before I set out, I shall desire to have a patent for making of wings, and that none shall

[1] *A Voyage to Cacklogallinia*, by Captain Samuel Brunt (pseud.), 1727, in which there are also traces of ideas from Wilkins A frontispiece shows the voyager conveyed through the air in a 'palanquin', supported by four large birds The idea of *A New Journey to the World of the Moon*, 1741, a political allegory, may be referred to the same source. A later book of the same class is *The Travels of Hildebrand Bowman*, 1778, with its curious account of a class of 'flying prostitutes' whose wings (though an object of imitation by the fashionable) develop as a consequence and sign of unchastity.

presume to fly, under pain of death, with wings of any other man's making. I intend to work for the court myself, and will have journeymen under me to furnish the rest of the nation. . . . You know, sir, there is an unaccountable prejudice to projectors of all kinds, for which reason, when I talk of practising to fly, silly people think me an owl for my pains ; but, sir, you know better things. I need not enumerate to you the benefits which will accrue to the public from this invention, as how the roads of England will be saved when we travel through these new *high-ways*, and how all family-accounts will be lessened in the article of coaches and horses. . . . In short, sir, when mankind are in possession of this art, they will be able to do more business in three-score and ten years, than they could do in a thousand by the methods now in use. I therefore recommend myself and art to your patronage, and am, Your most humble servant.'

In commenting on the projects of ' these our modern Daedalists ', Addison stated plainly that he was ' resolved so far to discourage it, as to prevent any person from flying in my time ', chiefly by reason of the evil influence ' it would have on love affairs '.

' It would fill the world with innumerable immoralities, and give such occasions for intrigues as people cannot meet with who have nothing but legs to carry them. You should have a couple of lovers make a midnight assignation upon the top of the monument, and see the cupola of St. Paul's covered with both sexes like the outside of a pigeon-house. Nothing would be more frequent than to see a beau flying in at a garret window, or a gallant giving chase to his mistress, like a hawk after a lark.'

Concluding in this spirit of raillery Addison defers raising ' many more objections ' until, as he says, ' I see my friend astride the dragon '.[1]

Owen Cambridge's *Scribleriad*, 1751.

An imaginative description of winged or mechanical flight which has the distinction of being inspired by the alleged achievement of Besnier in 1678, appeared in 1751 in *The Scribleriad*, a satirical poem by Richard Owen Cambridge (1717–1802), of some repute as a writer, and a friend of Dr. Johnson. Written in mock-heroic verse, with little to relieve its monotonous dullness, the poem was intended to ridicule the prevailing errors of learning and false taste. Incidentally the ' flying ' incident affords a strange prophetic parallel to (or suggests a perverse similitude of) the more heroic aerial encounters of the Great War. For that reason and no other, the passage may be quoted at length. It occurs in the

[1] Addison (J.), *Works*, by Hurd, vol v, 1811, p. 252 (*The Guardian*, no. 112).

description of the games which Scriblerus, the hero, is constrained to hold in celebration of the memory of the murdered Acrostick. Scriblerus, having urged the competitors in the 'aerial race' (the prize for which is a six-legged ox) to 'fit their light silken wings',

> . . . two youths of equal fire
> Spring from the crowd, and to the prize aspire.
> The one a *German* of distinguish'd fame:
> His rival from projecting *Britain* came.
> They spread their wings, and with a rising bound,
> Swift at the word together quit the ground.
> The *Briton's* rapid flight outstrips the wind:
> The lab'ring *German* urges close behind.
> As some light bark, pursu'd by ships of force,
> Stretches each sail to swell her swifter course,
> The nimble *Briton* from his rival flies,
> And soars on bolder pinions to the skies.
> Sudden the string, which bound his plumage, broke;
> His naked arms in yielding air he shook;
> His naked arms no more support his weight,
> But fail him sinking from his airy height.
> Yet as he falls, so chance or fate decreed,
> His rival near him urg'd his winged speed,
> Not unobserv'd. (Despair suggests a thought.)
> Fast by the foot the heedless youth he caught,
> And drew th' insulting victor to the ground:
> While rocks and woods with loud applause resound.[1]

The book is illustrated with engravings by Boitard, including one of the 'aerial race' (Fig. 5), a subject treated by the artist with less imaginative skill than in the plates he did to *Peter Wilkins*. The Englishman, with diminutive fan-shaped wings—of which it can only be said that they are adequate to the impression conveyed in the text by the breaking of a string—is clutching in distress at the legs of his German rival. The flying apparatus of the latter was (as the author acknowledged) simply copied from the figure of Besnier's 'Engine for Flying', which accompanied Hooke's contemporary account of the exploit.[2]

[1] Cambridge (R. O.), *The Scribleriad: An Heroic Poem*. In six books, 4to, 1751, Book IV, lines 135–56. The second book has a similarly prophetic account of a submarine boat, as suggested by Bishop Wilkins in his *Mathematical Magick*, 1641. The lines referring to the latter, together with those above quoted, have been privately printed for H. C. Levis, under the title of *An Aerial Race between a Briton and a German*, &c., 1918.

[2] See Ch. II, p. 77.

FIG. 5 AN AERIAL RACE BETWEEN A BRITON AND A GERMAN.
From Owen Cambridge's *Scribleriad*, 1751.

Paltock's Peter Wilkins, 1751.

In 1751 there also appeared the well-known story of *Peter Wilkins*, which, dealing with adventures among an aerial race, certainly possesses greater charm in fancy and imagination than Godwin's forgotten tale.[1] Of the author, Robert Paltock, whose fame lives solely by reason of his novel, hardly more is known than that he lived some years in Clement's Inn, and on his death in 1767 was buried at Ryme Intrinsica, in Dorset. Published anonymously, the authorship of *Peter Wilkins*—a title probably suggested by the patronymic of the author of *Mathematical Magick*—remained unknown till 1835, when Paltock's name was revealed by the discovery of the original agreement for the sale of the manuscript to Robert Dodsley, the publisher.

The character of the story, which—with what Coleridge called its 'desert island' feeling—recalls that greater achievement in the literature of shipwreck and adventure, *Robinson Crusoe*, can hardly be better conveyed than in the words of the original title-page:

> 'The Life and Adventures of Peter Wilkins, a Cornish Man: Relating particularly, His Shipwreck, near the South Pole, his wonderful Passage thro' a subterraneous Cavern, into a kind of New World; his there meeting with a Gawry or flying woman, whose Life he preserv'd, and afterwards married her; his extraordinary Conveyance to the Country of Glums and Gawrys, or Men and Women that fly. . . . Taken from his own Mouth, in his Passage to England from off Cape Horn in America, in the Ship Hector.'

The title further informs the reader that the volume is illustrated with 'cuts', or engraved copper plates (by Boitard), 'clearly and distinctly representing the Structure and Mechanism of the Wings of the Glums and Gawrys, and the Manner in which they use them either to swim or fly'. It is more than doubtful, however, whether the illustrations and the detailed descriptions combined ever convey any more definite ideas than that these winged people were born with a peculiar composite covering of pliable ribs and springy membranes, which when extended becomes sufficiently rigid to form wings, and when closed 'sits so close and compact to the body, as no tailor can come up to it'.[2] Nevertheless the

[1] *The Life and Adventures of Peter Wilkins*, by R. S., 2 vols., 1751. The story was justly praised by Scott, Southey, and Lamb, and in later times by A. H. Bullen, in the introduction to his excellent reprint (1884). It was translated into French (1763) and German (1767). Dramatic performances based on the story were popular early in the nineteenth century.

[2] In an account of a 'voiture volante' invented by the Abbé Desforges, in the *Journal Encyclopédique* for 1772 (vol. viii, pt. 1, pp. 118–22), it is said that the author 'pourroit bien avoir pris l'idée dans Les Hommes Volans, ou les aventures de Pierre Wilkins'.

story is undeniably attractive—of the heroine, Youwarkee, Leigh Hunt declared with enthusiasm that 'a sweeter creature is not to be found in books'—though such delight as it conveys lies in Paltock's quaint imagination and the quiet charm of his narrative, rather than in the fact (perhaps in spite of it) that the author endowed his creations with 'graundees' or wings (Fig. 4). Indeed, beyond the frank curiosity evinced by Peter Wilkins as to the organic nature of the wings whereby his 'dear Youwarkee' is enabled to fly—an incident related with a *naiveté* and delicacy some modern novelists might well emulate—there is no sign throughout the book of that enthusiasm for flight with which Godwin endowed Domingo Gonsales.

It may be added, on the other hand, that Paltock's imagination in the way of aerial contests far outran the stilted conception of Owen Cambridge. In the course of his adventures in Doorpt Swangeanti—'the land of flight'—Peter, called upon to defend the kingdom against rebels, commands the 'glums' (flying men) to bring cannons, powder, and shot from his wrecked ship—an achievement which induces the reflection that were his own countrymen able to adopt this aerial method of military transportation 'the whole world would not stand before us'. On being attacked by the van of the rebel army—'consisting of about five thousand men, who flew in five layers, one over another'—Peter, in the character of the first air-craft gunner, fires at close range with such effect as to bring down about 300 of the enemy. Finally he completes the discomfiture of the enemy's aerial hosts by firing again with the cannons, with the result, he says, 'they fell so thick about me, that I had enough to do to escape being crushed to death by them'—a contingency which adds unthought of horrors to recent highly coloured conceptions of vast aerial operations in the next war.

The Adventures of John Daniel, 1751.

Another 'desert island' romance of flying interest—written, according to Lowndes, in imitation of *Peter Wilkins*—appeared in the same year under the title of 'The narrative of the Life and astonishing adventures of John Daniel, a smith, at Royston in Hertfordshire'. The aeronautical ideas of the author—the title-page conveys that the book is by the Rev. Ralph Morris—were of a more mechanical cast than those of Paltock; for the son of the shipwrecked smith is described as experimenting with plane surfaces on the resistance offered by the air, and the support thus afforded

to his own weight. Subsequently the youth builds a machine, consisting in the main of a flat surface (like a floor or stage) in a frame of wood and finely wrought iron-work, beneath which were several ribbed wings—'cloathed with callicoe dipt in wax'—actuated by means of a pump and enabling him to fly in the air 'without any other support than a sea mew hath'. Despite the doubts and fears of his father, the young mechanic mounts his 'Eagle', begins to work his pump-handle, and (in the words of the parent's narrative) 'rising gently from the posts, away he went, almost two miles; then working his contrary handle, as he told me, he returned again, and passed by me to the other end of the mountain; then soaring a little as he came near me again, Father, says he, I can keep her up, if you can guide her to the posts'. Having assisted in landing the machine on a prepared staging, the astonished parent is induced to go for a flight, when 'making all fast, Father, says he, lie you, or sit close to the pump on that side, whilst I work it on this; and seeing me somewhat fearful, Don't be afraid, says he, hold by the pump irons, you are as safe here as on the solid earth; then plying his handle, we rose, and away we went'.[1]

Dr. Johnson on Flying and Ballooning, 1759–84.

Passing to Paltock's greater contemporary, Samuel Johnson, the first era of practical aeronautics is within sight, for Johnson lived to read of and to discuss the invention of the balloon by the Montgolfier brothers in 1783. Moreover, though reference is not infrequently made to the 'Dissertation on the Art of Flying', which forms the sixth chapter of *Rasselas*, Johnson's personal interest in ballooning was—as related in a subsequent chapter—more keen than has been hitherto realized.

Johnson's earliest reference to aeronautics is in the 199th number of *The Rambler*, which appeared in February 1752, and in which an imaginary correspondent, signing himself 'Hermeticus', is made to say that among other adventures he had twice dislocated his limbs and once fractured his skull in essaying to fly.[2] Seven

[1] See Lowndes (W. T.), *Bibliographer's Manual*, 1864, vol. ii, p. 586, where this book appears under Daniel (J.). The 'flying' incidents were reprinted by C. Clark at his private press under the title of *Flying and no Failure*, Totham, 1848. The description of this 'Eagle' applies so nearly to the caricature plate of 'A New Flying Machine upon Dr. Musgrave's Plan', which appeared in the *Oxford Magazine*, 1769 (see p. 342 *post*, and Grand-Carteret, p. 150), as to suggest that the latter was inspired by the former.

[2] A note on this passage in Murphy's edition of the *Works* states, 'we are informed that [Johnson] once lodged in the same house with a man who broke his legs in a daring attempt to fly.' But there is no mention of the fact in Birkbeck Hill's edition of Boswell's *Life*, 1887, or elsewhere.

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The 'Dissertation on the Art of Flying', in *Rasselas*, 1759.

years later Johnson enlarged his ideas of flight in the above-mentioned chapter of *Rasselas*, wherein the prince—meditating on his escape from the Happy Valley—becomes interested in the project of a mechanic 'Artist' who is engaged on a machine for flying with the aid of wings. The prince points out the difficulties—of a kind clearly suggested by the speculations of Bishop Wilkins—but the artist, confident of success, proceeds in reply to state in terms which, for the first time, formulated with approximate accuracy the scientific principle of 'heavier-than-air' flight: 'You will be, necessarily, upborne by the air, if you can renew any impulse upon it, faster than the air can recede from the pressure'.[1] 'I have been long of opinion', he adds, 'that instead of the tardy conveyance of ships and chariots, man might use the swifter migration of wings, that the fields of air are open to knowledge, and that only ignorance and idleness need crawl upon the ground.' Though the glowing enthusiasm of the artist carried him farther than the scientific knowledge of the day warranted—for instance in the passage on the decreasing powers of the earth's attraction at great heights (a notion which Johnson also appears to have borrowed from Wilkins)—his eloquent invitation to the prince to imagine the delights and possibilities of flight, which must have seemed utterly impossible to eighteenth-century readers, was in fact only prophetic. 'How easily', he suggests, 'shall we then trace the Nile through all its passage; pass over to distant regions and examine the face of nature, from one extremity of the Earth to the other.' Moreover, there was imaginative force in the artist's desire to keep secret his invention, for what, says he, 'would be the security of the good, if the bad could at pleasure, invade them from the sky?' Further objections raised by the prince call forth the admirable reply—well fitted to have stood as the motto for generations of aeronautical inventors—that 'nothing will ever be attempted if all possible objections must be first overcome'. Nevertheless Johnson himself was clearly sceptical, for the chapter concludes with the ignominious failure of the mechanic, who leaps from a promontory only to fall headlong into the lake over which, with laudable discretion, he essays to fly. In a final touch of delicate satire the author expressly points

[1] These actual words are used almost verbatim in an abridgement of the patent specification for a 'flying machine' invented by J. S. Phillips in 1861. (See Brewer and Alexander, p. 25.)

out that the wings with which the artist had furnished himself, though ' of no use in the air ', sustained him in the water, whence (in a manner again prophetic of the experiences of some of the early balloonists) he is rescued by the prince.[1]

Twenty-three years later Johnson learned that his own imaginings had become in some measure an accomplished fact.[2]

But romance and imagination have thus far outstripped—in accord, as may be urged, with their true function—the confines of time or the slow evolution of ideas as revealed in the story of aeronautics. It is necessary to return to a much earlier period in order to unravel the slender threads of a more scientific conception of flight, as far as they can be traced from the thirteenth century onwards. Before doing so, however, it is worth noticing that the legends and romances on flying dealt with in the foregoing chapter are all based on winged flight. Possibly the only reference of British origin to any sort of aerostatic or ' lighter-than-air ' conception, is the legend of the ' cloud-ship ' recorded by Gervase of Tilbury in the *Otia Imperialia*, written early in the thirteenth century. The legend runs that on a misty morning the folks thronging out of a church ' somewhere ' in Great Britain marvelled to find an anchor caught fast against a tombstone, attached to a taut rope reaching up ' into the upper sea [that] lieth above us '. Their astonishment was greatly increased when cries were heard from overhead, and the crew of the invisible ' airship ' sent one of their number down the rope, hand under hand, to release the anchor. Caught by the amazed onlookers he immediately expired —stifled by our gross air as a ' shipwrecked mariner is stifled in the sea '—whereupon his fellows ' cut the cable, left their anchor, and sailed away '. The anchor was removed and forged into iron bands for the church door—one of many such exists, for example, at Sempringham—' which bands ', adds the credulous Gervase, ' are still there for all men to see '.[3]

[1] Johnson (S.), *Rasselas, Prince of Abissinia*, ch. vi.

[2] See Ch. IX for some account of Johnson's connexion with ballooning.

[3] See Coulton (G. C.), *Social Life in Britain*, 1918, p. 538. The third part of the *Otia* was edited by F. Liebrecht, Hanover, 1856.

CHAPTER II

EARLY SCIENTIFIC SPECULATIONS

Roger Bacon (1214–92).

If King Bladud's name is associated with the earliest recorded, albeit legendary, attempt at actual flight in England, Roger Bacon was probably the first Englishman to write on the subject in any mechanical or scientific sense—certainly his are the oldest extant speculations. It must be remembered that the 'Doctor mirabilis' (as he came to be known) was a man of remarkable intellectual powers far in advance of his time, most notably, perhaps, in his clear perception of the great importance of experimental science. While he strongly condemned the use of magical arts, the breadth and scientific character of his conception of the objects of speculative alchemy give him a place apart from the alchemists of the era in which he lived, and entitle him to be regarded rather as a chemist. In 'The Secrets of Art and Nature' (written about 1250), he sought—to quote the translation in the Oxford volume of *Commemoration Essays on Roger Bacon*, 1914—to 'demonstrate the inferiority and indignity of magical power to that of Nature and Art', by discoursing 'on such admirable operations of Art and Nature as have not the least magick in them'. Dealing first 'of such Engines as are purely artificial', he says it is possible to make a chariot move 'with an inestimable swiftness . . . and this motion to be without the help of any living creature'.

His Speculations on Flight, *ca.* 1250.

Then follow two short passages of great interest in the early annals of aeronautics, if only by reason of their appearance in the thirteenth century. They occur in the chapter 'Of Admirable Artificial Instruments', and may be quoted in the quaint language of an early English translation.[1] 'It 's possible', wrote Bacon, 'to make Engines for flying, a man sitting in the midst thereof, by turning onely about an Instrument, which moves artificiall Wings made to beat the Aire, much after the fashion of a Bird's flight.' Having described other mechanical devices, Bacon states that all of them have been actually constructed, with the notable

[1] *Frier Bacon: His Discovery of the Miracles of Art, Nature*, &c., translated . . . by T. M, 1659. The first English translation (from which Fig. 2 is reproduced) appeared in 1597. The *De mirabili potestate Artis et Naturae*, &c., was first printed at Paris, 1542. See also *Opera Inedita*, by J S. Brewer, 1859, Appendix, p. 533, and *D. N. B.*, vol. ii, p. 376.

exception of 'only that instrument of flying, which I never saw or know any who hath seen it, though I am exceedingly acquainted with a very prudent man, who hath invented the whole Artifice'. There are other brief references to 'instrumenta volandi' in the *Opus Tertium* and the unpublished treatise on mathematics, but there does not appear to be any authority for such other speculations of an aeronautical character as are sometimes attributed to Bacon.[1]

Francis Bacon (1561–1626).

Admittedly Roger Bacon's thoughts on the subject were little more than speculations on the possibility of the thing, and such references as are to be found, after the lapse of 400 years, in the scientific writings of Francis Bacon in the early part of the seventeenth century cannot be characterized more definitely. In the *Sylva Sylvarum* (being observations and experiments in natural history) published in 1627—the year after Bacon's death—there are two paragraphs, the more interesting of which, entitled 'Experiment solitary touching Flying in the Air', may be quoted at length.

Speculations on Flight in *Sylva Sylvarum*, 1627.

'It is reported that amongst the Leucadians, in ancient time, upon a superstition, they did use to precipitate a man from a high cliff into the sea; tying about him with strings, at some distance, many great fowls; and fixing unto his body divers feathers, spread, to break his fall. Certainly many birds of good wing (as kites, and the like) would bear up a good weight as they fly; and spreading of feathers thin, and close and in great breadth, will likewise bear up a great weight; being even laid, without tilting upon the sides. The further extension of this experiment for flying may be thought upon.'[2]

The second, 'Experiment solitary touching the Flying of unequal Bodies in the Air', is neither wholly intelligible nor strictly relevant.[3] Moreover, even when jointly considered, the two passages cannot

[1] See the edition of the *Opus Tertium*, by A. G. Little, 1912, p. 18. Wise, the American aeronaut (quoted by Hatton Turnor, p. 28), in referring to the way in which Bacon 'descants in glowing language', was unwarrantably indulging in that exercise himself. In the *Ency. Brit.* (11th ed, 1910–11, under Aeronautics (Aerostation), p. 261) it is stated that Roger Bacon 'conceived of a large hollow globe . . . filled with ethereal air . . . which would float on the atmosphere like a ship'. Though no reference is given the statement is probably taken from Wise (p. 20), but the writer is informed by Mr. Robert Steele that in his extended studies of Roger Bacon's writings the passage has not come under his notice.

[2] Bacon's *Works*, by Spedding, Ellis and Heath, 1857, vol. ii, p. 634.

[3] Op. cit., p. 596. This passage is quoted in the *Ency. Brit.*, 11th ed., p. 260, with the explanation that the fact 'alluded to is the resistance that bodies experience in moving through the air, which, depending on the quantity of surface merely, must exert a proportionally greater effect on rare substances'. But it is admitted that the statement is 'confused, obscure, and unphilosophical'.

be said to justify the claim sometimes made for Bacon, that 'he first published the true principles of aeronautics'.

One other reference to flight is made incidentally by Bacon in the *New Atlantis*—an imaginative description of an ideal community written in 1624. In a 'relation of the true state' of this Utopian society, one of its learned 'fathers' is made to give an account of the attainments and uses of experimental science as applied to the services of the community—an account remarkable for its extraordinarily diverse and prophetic character. In his exposition of the mechanical arts the philosopher says, 'We imitate also flights of birds; we have some degrees of flying in the air'—a claim which in its imitative aspect sums up in a sentence man's general attitude towards flight down to the close of the eighteenth century.[1]

Bishop Wilkins (1614–72).

In the scientific age of discovery and invention which followed on the death of Bacon in 1626, and for which his varied learning and eloquent vindication of large scientific principles had so greatly prepared the way, the writings of John Wilkins played no insignificant part in exciting interest in the problems of flight. Wilkins, who prior to his translation to the see of Chester in 1668 had acquired eminence as a teacher at Wadham College, and subsequently held the office of Master at Trinity College, Cambridge, was one of the founders (on its resuscitation in 1660) of the Royal Society, to which he acted as first secretary.[2] To his reputation as a distinguished and respected ecclesiastic was joined that of a scientific writer, as well as an experimentalist and philosopher. In 1638 he published his *Discovery of a New World, or a Discourse tending to prove that ('tis probable) there may be another Habitable World in the Moon*, the scientific thesis of which is adequately conveyed by the title, and to the third impression of which (printed in 1640) he added the *Discourse concerning the possibility of a Passage to the World in the Moon*.[3] It has been said it was from Godwin's 'flying

[1] Op. cit., vol. iii, p. 163.

[2] Both Pepys and Evelyn frequently met Wilkins and admired his conversational powers, though it is disappointing that neither diarist has any mention of the subject of flying. Pepys apparently found more interest in the bishop's philosophical *Essay towards a Real Character*, 1668, which pleased him 'mightily'.

[3] The *Discovery* was first published (anonymously) in 1638, and was reprinted with the additional *Discourse concerning Flying* (the latter being an enlargement of brief passages on the same subject in the first edition), in 1640 and 1684 Both these treatises, with the *Mathematical Magick*, &c., are included in the *Mathematical and Philosophical Works*, 1708 and 1802

romance' that Wilkins gathered hints for his more scientific speculations, but as a matter of fact he expressly states at the close of the Discourse on Flying, that having finished it, 'he chanced' upon Godwin's book, which he proceeds to characterize as 'a very pleasant and well-contrived fancy concerning a voyage to this other world'.[1] It should be added that both in the *Discourse* and in the later chapters on flight in *Mathematical Magick*, Wilkins affords ample evidence of his interest in the subject of flight by the references he makes both to classical and to earlier scientific writers.

The Discourse concerning Flying, 1640.

Starting from the premise that the discovery of the art of flying may prove in time to come to be no more incredible than did the invention of ships in the earliest ages—an analogy the force of which was elaborated at a later date by Fontenelle in the *Plurality of Worlds*[2]—he first answers the three chief objections which then appeared to render flight impossible, viz. the natural heaviness of man's body, the extreme coldness of the ethereal air at high altitudes, and also the extreme thinness of it. The first objection is mainly argued on the ground that if it were possible for man to fly upwards about twenty miles, the forces of gravitation, or magnetic virtue which proceeds from the earth, would be overcome; he might then stand as firmly in the open air as he now stands upon the ground, and as a consequence be able to move without impediment and with great swiftness. Incidentally he refers to the 'pretty notion' of Albertus de Saxonia, that 'the air is in some part of it navigable', and that as in the case of a metal vessel floating on the water by reason of the displacement of an element heavier than air, so it may be supposed that a 'Cup, or Wooden vessel upon the outward borders of this elementary air, the cavity of it being filled with fire, or rather aethereal air, it must necessarily upon the same ground remain swimming there, and of itself can no more fall, than an empty ship can sink'.[3] This idea of a 'lighter-than-air' machine was developed in the further speculations on flying subsequently published in the *Mathematical Magick*.[4]

Having discussed the difficulties of the extreme coldness and thinness of the air, Wilkins offers three brief conjectures as to the

[1] See Wilkins (J.), *Works*, 1708, 'Discovery of a New World', p 134.

[2] Translated by J. Glanvill, 1688. See *post*, p. 82.

[3] Op. cit., p. 123, where Wilkins gives the reference as *Phys.*, l 3, Q. art 2. 6. He also refers to Francis Mendoça (*Viridarum eruditionis*, l. 4, prob. 47).

[4] Op. cit, lib. ii, ch. viii, where the experiments of Archimedes in his *De insidentibus humido* are mentioned in this connexion.

means by which it may be possible to ascend ' beyond the sphere of the earth's magnetical vigour ' : firstly, by the application of mechanical wings to man's own body ; secondly, by the help of some large bird ; and thirdly, he seriously affirms on good ground that ' it is possible to make a flying-chariot, in which a man may sit, and give such a motion unto it, as shall convey him through the air '. ' And this ', he adds, ' might be made large enough to carry divers men at the same time, together with food for their *viaticum*, and commodities for traffic.'

His further Specula- tions in *Mathemati- cal Magick*, 1648.

Eight years later he published his *Mathematical Magick*, divided into two parts, entitled ' Archimedes, or Mechanical Powers ', and ' Daedalus, or Mechanical Motions '. In the latter he treats of the possibilities and means of flight more fully in three chapters, entitled respectively, ' Of the Volant Automata, Archytas his Dove, and Regiomontanus his Eagle. The Possibility, and great Usefulness of such Inventions ', ' Concerning the Art of Flying. The several ways whereby this hath been, or may be attempted ', and ' A Resolution of the two chief Difficulties that seem to oppose the Possibility of a Flying Chariot '.[1] The importance and value of flight he clearly realized as being an achievement ' than which there is not any imaginable invention, that could prove of greater benefit to the world or glory to the author '.[2] He deals first with ' volant or flying automata ', that is ' such mechanical contrivances as have a self-motion, whereby they are carried aloft in the open air like the flight birds '. Answering Jerome Cardan's objections to such machines, he quotes the latter's admission that the wind may assist in flight, though without appreciating the full significance of that factor, and he dismisses a quotation from Aulus Gellius as to the possibility of containing some lamp or other fire within the machine, ' which might produce such a forcible rarefaction as should give a motion to the whole frame ', with some wholly vague remarks on the more convenient use of springs.[3] But while theorizing on the subject of flight he realized the importance of practical experi-

[1] Wilkins (J.), *Mathematical Magick*, 1648, Daedalus, lib. ii, chs. 6–8.

[2] Wilkins had also referred briefly to the matter in his *Mercury : or the Secret and Swift Messenger*, 1641 (a treatise on secret writing and signalling), where he wrote that ' amongst all other possible Conveyances thro' the Air, Imagination it self cannot conceive any one more useful, than the Invention of a flying Chariot ' (*Mercury*, 1707 edition, p. 19).

[3] Cf. [Powell (T.)], *Humane Industry*, 1661, p. 28, where it is suggested that the ' Wooden Dove ' of Archytas was made to fly ' by the means of Ayr pent or inclosed within, which in the motion being somewhat rarified, kept it up aloft, and with some wheels contrived in the concavity thereof, did set it forward '. Powell also refers to the wooden eagle and iron fly of Regiomontanus.

ments—' unless a man be able to go to the trial of things he will perform but little '. Indeed, he expressly states that he can only propose the theory and general grounds of the subject, for the encouragement of ' those that have both minds and means ' for experimental researches, in which connexion he relates the story of the allowance made by Alexander to Aristotle for scientific purposes, with the pregnant comment that ' the reason why the world hath not many Aristotles, is because it hath so few Alexanders '.

In the next chapter, ' Concerning the Art of Flying ', he prefixes a fourth method, ' By spirits or angels ', to the three previously discussed in the *Discourse*, fully aware, nevertheless, that the relations which he records from Scripture and elsewhere cannot conduce to any discovery on natural or artificial grounds. Dealing with the conjectured possibility of conveyance through the air by the help of large birds, he again refers to Godwin's fiction as the ' most pleasant and probable ' in this manner, and quotes Bacon's comment on the superstitious practice of the Leucadians.[1] He then discusses at greater length the first of the two mechanical methods of attaining to flight, namely by using ' wings fastened immediately to the body ' after the manner of birds,[2] though he allows that such attempts as have been made in this way have usually resulted in broken legs and arms—an admission followed by the naïve suggestion that such misfortunes have only resulted from ' want of Experience and too much Fear, which must needs possess Men in such dangerous and strange attempts '. He contends that skill and confidence will only be attained by constant practice in the art from youth, ' trying first only to use [the] wings, in running on the ground, as an ostrich or tame geese will do, touching the earth with his toes '—an intelligent anticipation of the modern analogy afforded in the practice of ' taxying ' an aeroplane. Indeed, Wilkins relates ' on credible testimony ' the modest achievement of one of his countrymen, who had ' proceeded so far in this experiment that he was able by the help of wings, in such a running pace, to step constantly ten yards at a time '. But he foresaw—as Borelli conclusively demonstrated at a later date[3]—that a man's arms

[1] See *ante*, p. 69.

[2] Wilkins refers to this method as the one recommended by Flayder in his *De Arte Volandi* [Tubingen], 1628.

[3] Borelli (G. A.), *De Motu Animalium*, 1680–1, prop. 204, ' Est impossibile, ut Homines propriis viribus artificiose volare possint ' (vol. i, pp. 322–6). A translation of the section ' De Volatu '—which treats on the flight of birds—was published by the Royal Aeronautical Soc. in 1911.

would be easily wearied, and he suggested that a more satisfactory result might be 'expected by the labour of the feet, which are naturally more strong and indefatigable'. 'In such a contrivance', he continues, 'the wings should come down from the shoulders on each side, as in the other, but the motion of these should be from the legs being thrust out, and drawn in again one after another, so as each leg should move both wings, by which means a man should (as it were) walk or climb up into the air'.[1]

But to Wilkins the fourth and last way, that of a 'flying chariot', seemed altogether as probable and much more useful than the rest, and in the chapter entitled, 'A resolution of the two chief difficulties that seem to oppose the possibility of a flying chariot', he enlarges on the subject.[2] The difficulties are stated as being: (1) Whether an Engine of such Capacity and Weight may be supported by so thin and light a Body as the Air?; and (2) Whether the Strength of the Persons within it may be sufficient for the Motion of it? As to the first he argues on sound principles 'that the engine can never be too big or too heavy, if the space which it possess in the air, and the motive-faculty in the instrument, be answerable to the weight'. The observations which follow on the flight of birds—particularly of a kite—show clearly, however, that his thoughts were mainly on the lines of an imitation of nature.

In the next paragraph, however, Wilkins points out that just as bodies 'tho' they be never so big or so ponderous' will always float on the water, provided they displace more than their own weight, so likewise it is not the 'greatness (tho' never so immense)' of bodies in the air which 'can hinder their being supported in that light Element, if we suppose them to be extended into a proportionable Space of Air'. Here is an adequate statement of the 'lighter-than-air' principle, based on the physical law of Archimedes (to which Wilkins refers) governing the flotation of bodies in fluids, which leads to the suggestion that 'it is possible to raise a new science, concerning the extension of bodies, in comparison to the air, and motive faculties by which they are to be carried'.[3]

[1] Cf. Willughby's remarks on bird flight (*post*, p. 80).

[2] A remarkable engraving designed by Filippo Morghen (born in Florence, 1730), to illustrate the *Discovery*, was published at Naples in 1764, and is reproduced by Bruel, no. 194. It depicts a balloon floating above a car or gondola, which latter is fitted with two fan-like wings and a tail.

[3] Op. cit., Daedalus, lib. 2, ch. 8.

Passing to the second difficulty, Wilkins becomes more confused and vague—he mainly reverts to the probability that at any great height the attraction of the earth will cease to be felt, and suggests that it is this fact which enables migratory birds to undertake long flights. His suggestions as to the application of springs or manual power to the 'wings' of the proposed 'chariot', are wholly unsatisfactory, and justify the criticism of Cavallo that they afford 'nothing precise about flying' and are incapable of furnishing 'any hints useful to a rational schemer'. On the other hand a final quotation from the *Mathematical Magick* will serve to show that Wilkins must be credited with general conceptions of flight not less remarkable in point of time than they are in respect of rational expression. Having pointed out that the difficulty of contriving 'any such motive power' as shall be equal to the purpose of a flying 'instrument' does not impair 'the Truth to be maintained', Wilkins proceeds:

'For if the possibility of such a Motion be yielded, we need not make any scruple of granting the Difficulty of it; It is this must add a Glory to the Invention; and yet this will not perhaps seem so very difficult to any one who hath but diligently observed the Flight of some other Birds, particularly of a Kite, how he will swim up and down in the Air, sometimes at a great height, and presently again lower, guiding himself by his Train, with his Wings extended without any sensible Motion of them; and all this, when there is only some gentle breath of Air stirring, without the help of any strong forcible Wind. Now I say, if that Fowl (which is none of the lightest) can so very easily move it self up and down in the Air, without so much as stirring the Wings of it, certainly then it is not improbable, but that when all the due Proportions in such an Engine are found out, and when Men by long Practice have arrived to any Skill and Experience, they will be able in this (as well as in many other Things) to come very near unto the imitation of Nature.' [1]

In any case whatever view be taken as to the character of the writings of Wilkins on flight in general, it is clear that those writings were widely read, and that his ideas on flight were, in his own day and for long after, the subject of countless discussions. Wilkins died at the house of his friend, Dr. John Tillotson, in Chancery Lane, on November 19, 1672.

Robert Hooke (1635–1703).

A more strictly scientific examination of the mechanical and practical aspects of both 'heavier' and 'lighter-than-air' flight was the work of Robert Hooke, a friend of Bishop Wilkins, whom

[1] Op cit., Daedalus, lib. 2, ch. 8, cf. Cavallo, p 19, where Wilkins's 'vague discourse' is dismissed as containing 'nothing precise about flying'.

he followed (on the death of Henry Oldenburg) as secretary of the Royal Society between 1677 and 1682. Hooke was educated as a pupil at Westminster School under Dr. Busby, when (among other precocious accomplishments) he is said to have 'invented thirty several ways of flying '.[1] Later in life he assisted Robert Boyle in experiments with his air-pump, and by his extensive and varied researches in physics—the *Micrographia*, 1665, wherein he pointed out the real nature of combustion, is his best-known work—in optics, and in astronomy, he earned a high reputation as an experimental scientist. Moreover, he has been described as the greatest mechanic of his age, an estimate in support of which the contemporary judgement of Evelyn can be adduced.[2] In the edition of Hooke's *Posthumous Works*, 1705, edited by Richard Waller, the editor printed (in the short life of the author prefixed) some notes by Hooke on the subject of flight, which testify to the fact that he not only turned his mind to the subject but actually conducted minor experiments in connexion therewith. In the year 1655 Hooke records that he

His Experiments with Model Flying Machines, 1655.

'contriv'd and made many trials about the Art of flying in the air, and moving very swift on the Land and Water, of which I shew'd several Designs to Dr. Wilkins then Warden of Wadham College, and at the same time made a Module [model] which, by the help of Springs & Wings, rais'd and sustain'd itself in the Air; but finding by my own trials, and afterwards by calculation, that the Muscles of a Man's Body were not sufficient to do anything considerable of that kind, I apply'd my Mind to contrive a way to make artificial Muscles; divers designs whereof I shew'd also at the same time to Dr. Wilkins, but was in many of my Trials frustrated of my expectations.'

Waller informs us that 'what is mentioned here of his attempts about flying, is confirm'd by several Draughts and Schemes upon Paper, of the Methods that might be attempted for that purpose, and of some contrivances for fastening succedaneous Wings, not unlike those of Bats, to the Arms and Legs of a Man, as likewise of a Contrivance to raise him up by means of Horizontal Vanes plac'd a little aslope to the Wind, which being flown round, turn'd an endless screw in the Center, which help'd to move the Wings, to be manag'd by the Person by this means rais'd aloft '. 'These Schemes ', Waller adds, 'I have now by me, with some few Frag-

[1] See *D. N. B.*, vol. xxvii, pp. 283–7.

[2] Evelyn's *Diary*, by Bray and Wheatley, 1906, vol. ii, p. 186, where Dr. Wilkins and Hooke, together with Sir W. Petty, are characterized as three men unequalled in Europe 'for parts and ingenuity '.

ments relating thereto, but so imperfect, that I do not judge them fit for the Publick.'[1] Though it is true such studies cannot be compared with the more notable spheres of Hooke's experimental activities—for instance in physics and optics—they are of considerable interest as being the earliest known, albeit incomplete and tentative efforts, of an English scientist engaged in laboratory experiments on flight. Indeed, if Hooke's words are accepted literally, his ornithopter model was conceivably the first model 'flying machine' which actually flew, and in any case there is a suggestive significance in the 'horizontal vanes placed a little aslope to the wind'. Moreover, the subject occupied a place in Hooke's mind for many years, for in February 1674 he wrote 'that he knew a way of making succedaneous Muscles for a Man to supply the defect of his Muscles in flying, and give one man the strength of ten or twenty, if required'. Further, in some observations on the nature of the flying fish, Hooke pointed out that feathers in wings or tail are not essential for flight, and he adds, 'perhaps could there be made an Artificial Repository or Magazine of Strength, which for Weight and Bulk would not be too cumbersome; 'tis not impossible to fit a pair of Wings for a Man to fly with, which may be contriv'd somewhat after the Manner of the long Fins of these flying Fish'.[2]

His Examination of Besnier's Flying Apparatus,

In 1679, during his tenure of office as secretary of the Royal Society, Hooke commenced the publication of seven numbers of so-called *Philosophical Collections*—which he substituted for the *Transactions*—consisting of brief reports of the latest scientific observations and notices of new books.[3]

In the first number he reprinted (in English) from the *Journal des Sçavans* for 1678, the 'Extract of a Letter written from M. Toynard, concerning a Machine newly Invented for Flying in the Air, by the Sieur Besnier', prefacing it with some remarks on earlier projects wherein he referred to 'several ingenious men'

[1] Hooke (R.), *Posthumous Works*, by R. Waller, 1705, *Life*, p. iv. Amongst Hooke's manuscript papers in the Library of the Royal Society the only references to flight which the present writer could discover were three notes on a 'List of Experiments, &c.'—'Various ways of Flying', 'The way of poising Gonsales Birds', and 'Things worthy tryall at a great height in ye air as Kites' (*Classified Papers*, vol. xx, no. 54).

[2] Op. cit., *Method of Improving Natural Philosophy*, p. 57.

[3] Hooke (R.), *Philosophical Collections*, no. 1, 1679, pp. 14–29. In the second number of the *Collections* Hooke deals briefly with Borelli's book, *De Motu Animalium*, but he makes no mention of the discussion on flight contained therein—probably because the book had not then been published in its entirety (see note, p. 73).

who had lately 'employed their wits and time about this design' in England. 'Particularly, I have been credibly informed', he adds, 'that one Mr. Gascoyn did about forty years since try it with good effect; though he since dying, the thing also dyed with him'. But Hooke desists from random conjectures, on the ground of entire lack of knowledge as to the mechanism whereby these alleged performances had been attained, and from the fact that they had not been brought into common use—'which the desirableness and usefulness of any one that should succeed would certainly cause [them] to be'—he deduces the inference that they were defective 'in somewhat or other'. Certainly the contrivance under discussion—the invention of a smith named Besnier, of Sablé, in the county of Maine—though some particulars of it were known to Hooke, must have appeared to him as within the categories suggested in his admirably vague but comprehensive phrase. It consisted simply of two rods or poles, at each end of which was fixed an 'oblong chassie of taffety, which chassies [or wings] fold from above downward'.[1] This primitive apparatus, supported on and presumably fixed to the shoulders, was worked by alternating movements of hands and feet, the hands grasping the rods in front and the feet attached by cords from behind. Besnier did not pretend to be able to raise himself from the earth by his 'machine', nor was he able to sustain himself in the air for any long time, owing to the rapid exertion necessary; but it was claimed that starting first by springing from a stool, then the top of a table, then a pretty high window, a second floor, and lastly from a garret, he did achieve a flight over the houses of his neighbours. Apparently his success was shortlived, for Hooke adds a note to the effect that later news showed Paris was becoming sceptical of Besnier's ability to fly, owing to the non-renewal of his alleged achievement, and indeed to his subsequent disappearance.

and of Lana's Aerial Ship, 1679.

In the same number of his *Philosophical Collections* Hooke gives a translation—the first in English—of the sixth chapter from Lana's *Prodromo*, an exhaustive treatise on the sciences published at Brescia in 1670. The chapter in question comprises Lana's exposition of his 'Aerial Ship', notable as being the earliest known conception of an aeronautical 'engine which should be lighter than

[1] An engraving to the first number of the *Collections* contains figures of both Besnier's flying apparatus and Lana's aerial ship (see Fig 7). As to the former, cf. La Vaux, no. 2.

FIG. 6. JOHN WILKINS, Bishop of Chester
Wrote on *The Art of Flying*, 1640–48

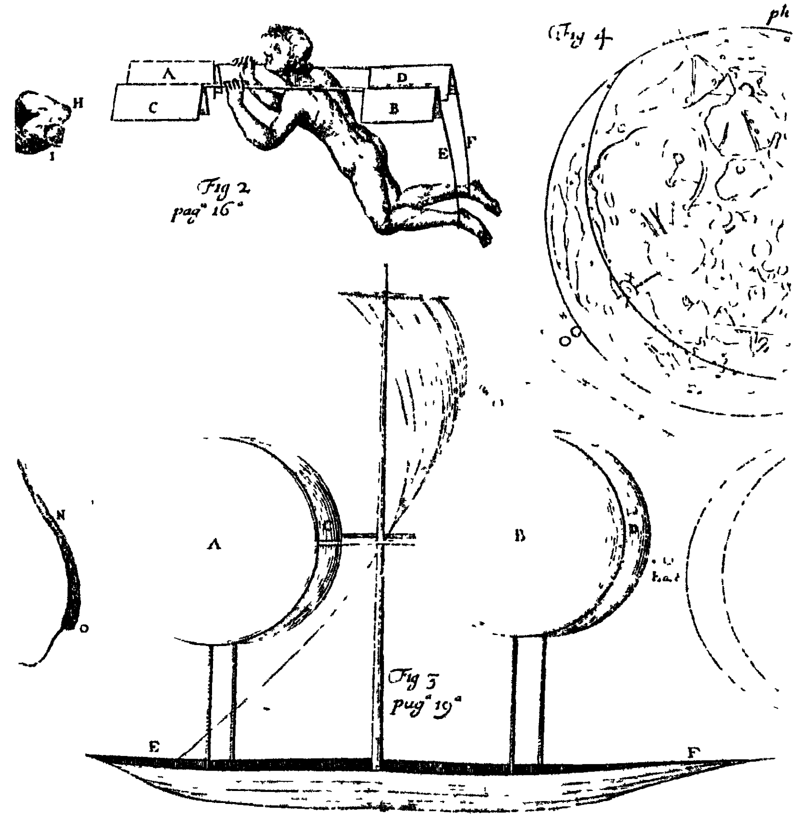


FIG 7 Plate from Hooke's *Philosophical Collections*, 1679
Showing Besnier's Flying Machine and Lana's Flying Boat

the air '—a subject with which, owing to the character of his own scientific investigations, Hooke was fully qualified to deal.[1] The project of Francesco Lana (1631–87), a Jesuit priest of considerable scientific attainments, is too well known to need any full description. In the main it was a proposal to make use of the Archimedian or ' static principle ', by means of globes floating in the atmosphere, as a ship does in the water. This was to be attained by exhausting the air from four large globes of thin copper, which, weighing less than an equal volume of air, would not only float themselves, but would sustain a boat capable of holding men to navigate it. In his interesting examination Hooke points out in the first place that Lana is wrong in calculating air as being only 640 times lighter than water, whereas it is in reality 800 times lighter. ' Next 'tis granted ', he says, ' that Spheres are to one another, as the Cubes of their Diameters, whereas the surface of them are only as to the squares of their Diameters '. But this has an important bearing on Lana's assumption that copper of three ounces to a foot square would be of sufficient thickness in a globe 14 feet square, or of any dimensions, the fact being that such globes—the larger still less than the smaller—could not possibly withstand the pressure of the atmosphere from without. As Hooke, taking up the metaphor used by Lana, picturesquely observes in conclusion, it is ' in this lies the fallacy of the Author's Reasoning, and this is the Rock that has precipitated his ship to the Ground, and not the tops of the Mountains, nor the Whirl-Winds in the Air '—a fact which he trusts will clear Lana from misgivings aroused in the inventor himself, by the thought of the dangers which would result to the ' Civil and Peaceful Government of the World ' from the invention of the aerial ship.[2]

Francis Willughby on Bird Flight, 1676.

Though in no way concerned with the mechanics of flight, the ornithological writings of Francis Willughby (1635–72), a contemporary of Wilkins and Hooke, and an original Fellow of the Royal Society, contain some interesting observations on the flight of birds which testify to the growing interest in the subject. In his great work, the *Ornithologiae libri tres*, published posthumously in 1676, Willughby points out that the strength of a bird's

[1] Lana (Francesco), *Prodromo overo Saggio*, &c., Brescia, 1670. The preceding chapter (v) treats of flying automata. See the translation of both chapters with a biographical notice published by the Aeronautical Society as No. 4 of the *Aeronautical Classics*, 1910 Also Boffito, p. 131, &c

[2] See p. 27 of the Aeronautical Society's translation.

wings is comparable with that of a man's legs, rather than with his arms.

'The Pectoral Muscles [to quote from the English translation by John Ray published in 1678] and such as serve to move the wings, are of all others the thickest and most fleshy. For since the flight of Birds is not performed without a strong motion, and vehement agitation of the wings, to which force is required, it was requisite the organs designed for that exercise should be the strongest and most able. On the contrary in man the Muscles which serve to move the Legs, are greater & stronger than those which belong to the Arm: Because their action being to hold up the whole body, & transfer it from place to place, requireth great ability & vigour. Whence, if it be possible for man to fly, it is thought by them who have curiously weighed and considered that matter; that he that would attempt such a thing with hope of success, must so contrive & adapt his wings, that he may make use of his legs & not his arms in the managing of them.' [1]

The Marquis of Worcester's *Century of Inventions*, 1663.

The subject of flight as a mechanical proposition was very briefly touched upon about the same period by Edward Somerset, second Marquis of Worcester (1601–67), who devoted no mean inventive ability, combined with much time and large sums of money, to mechanical experiments in general. Imprisoned for Royalist activities, he was released in 1654, and recovered most of his property at the Restoration. His *Century of Inventions*—written in 1655, and chiefly interesting, perhaps by reason of the ingenious adumbration of a steam pumping-engine which it contains—is a summary record of one hundred inventions which the author claimed 'to have tried and perfected'.[2] The seventy-seventh invention is set out—in the fewest imaginable words—as a method, 'How to make a man to fly; which I have tried with a little Boy of ten years old in a Barn, from one end to the other, on a Hay-mow'. As Worcester did not live to fulfil his intention—avowed at the conclusion of the *Century*—of leaving to 'Posterity a Book wherein under each of these Heads the means to put in execution and visible trial', was to have been printed, it is difficult to agree with the suggestion of an enthusiastic editor of this remarkable book, that Worcester might have 'gone far to anticipate Montgolfier in producing a balloon'. Indeed, the bald statement of fact—if it be a fact—affords no possibility of even guessing at the

[1] Doubtless Willughby had in mind the remarks of Wilkins as quoted on p. 74 *ante*. In another passage (on the use of the tail as a means of 'Steering') Willughby quotes Pliny's comment as to kites having 'taught men the Art of governing a ship by the flexures of their Tails, Nature shewing in the Air what was needful in the deep'.

[2] [Worcester (Marquis of)], *A Century of the Names and Scantlings of such Inventions as at present I can call to mind to have tried and perfected, &c*, 1663.

nature of the 'invention', unless indeed it be that the 'hay-mow', or rick, was merely incidental to the experiment, inasmuch as it was soft to fall on.[1]

For the next hundred years (reckoning from the latter part of the seventeenth until towards the close of the eighteenth century) no other scientific writers of eminence appear to have indulged in any reflections on aeronautics.[2] It is not surprising, moreover, that the speculative and undemonstrable character of the writings of such a philosopher as Bishop Wilkins, combined with the futility of any practical attempts that may have been made in England—as they certainly were made in France—tended to foster a spirit of incredulity and indeed of ridicule.[3] Burton, for instance, in the *Anatomy of Melancholy*, 1652, refers to the 'aerial progress' which the Turk (as recorded by Busbequius) made his fellow-citizens in Constantinople believe he would perform, only to dismiss the incident in the 'cynical phrase' (as Wilkins called it) 'that some new-fangled wits, methinks, should some time or other find out' the art of flying.[4] Butler, the author of *Hudibras*, in his satirical poem, 'The Elephant in the Moon', though bent on ridiculing the pretensions of the growing scientific spirit as typified in the Royal Society, clearly had the subject of Wilkins's book in mind, while Pope's lines in the *Dunciad*,

> The head that turns at super-lunar things,
> Pois'd with a tail, may steer on Wilkins' wings,

are more directly satirical of the bishop's twofold theme of a lunar world and the possibility of flying there.[5]

But the desirability of free and unfettered speculations and experiments in the world of scientific knowledge, which unfolded

[1] See Dircks (H.), *Life and Scientific Labours of the Marquis of Worcester*, with a Reprint of the *Century*, 1865. There is a long note to Invention 77, but no light whatsoever is thrown on Worcester's idea. Referring in brief (on p. 355) to the 'scheme for flying', Dircks points out (with naïve confidence in his author's claims) that this appliance, 'whether a balloon, wings, or a machine', had been tried!

[2] It must not be overlooked that the scope of this volume is confined to Great Britain.

[3] For instance, the Marquis de Bacqueville in 1742 made an attempt to fly with a winged apparatus. Leaping from a window of his hotel on the Quai des Théatins in Paris, he completely failed, and falling heavily upon a boat on the Seine, escaped with a broken leg (Tissandier, vol. i, 1887, pp. xx–xxi).

[4] Burton's *Anatomy of Melancholy*, Nimmo's edition, 1893, vol. ii, p. 143 (Part 2, sec. 2, mem. 3 Digression of Air).

[5] Pope's *Works*, by Elwin and Courthope, 1882, vol. iv, p. 213. (*Dunciad*, Bk. IV, lines 451–2). Warburton, in his edition (1742), adds a note—following his author's lead—to the effect that Wilkins's extravagant suggestion of flying to the moon 'has put some volatile geniuses upon making wings for that purpose'.

itself with the age, found enthusiastic supporters, and the comparatively recent discovery of the barometer, the thermometer, the microscope, and Boyle's air-pump, gave promise of great advances.

Joseph Glanvill (1636–80).

Probably the most learned and active of these defenders of experimental philosophy was Joseph Glanvill, a friend of Boyle, and also an original Fellow of the Royal Society. Trained as an Anglican divine, Glanvill combined what Lecky called an 'intense scepticism' and a mind which revolted against the aridity of the prevailing Aristotelian scholasticism, with a belief in witchcraft and a fervent interest in the beginnings of experimental science. In his first book, *The Vanity of Dogmatizing*, 1661, he attacked the scholastic philosophy then dominant at Oxford, elaborating his views in a revised edition published towards the end of 1664 under the title of *Scepsis Scientifica*. In his plea for the development of experimental science he suggests that doubtless 'posterity will find many things, that are now but *Rumors*, verified into *practical Realities*'. 'It may be', he continues, 'some ages hence a voyage to the *Southern* unknown *Tracts*, yea possibly the *Moon*, will not be more strange than one to *America*', and Glanvill even dared boldly to affirm (in a sentence first erroneously attributed to Wilkins by Addison) that 'to them that come after us, it may be as ordinary to buy a *pair* of *wings* to fly into remotest *Regions*, as now a *pair* of *boots* to ride a *Journey*'.[1]

His References to Flight in *Scepsis Scientifica*, 1665.

John Glanvill (1665–1735).

Some twenty years later John Glanvill—a grandson of the distinguished lawyer, Sir John Glanvill (1586–1661), but apparently no relation of the author of the *Scepsis Scientifica*—had fuller opportunities for indulging in thoughts on flight, when translating Fontenelle's *Entretiens sur la pluralité des Mondes*, 1686, which he first published in 1688 under the title of *A Plurality of Worlds*. As the title suggests, the book is an astronomical treatise cast in the form of a dialogue between the philosophical author and a certain quick-witted Countess of D——s. The discussion turning on the possibility of flying to the moon, the philosopher suggests that such an achievement may prove no more surprising than did Columbus's ocean crossing in ships appear to the native 'Americans', who themselves knew of nothing better than floating on the water in hollowed tree trunks. Being interrupted

His Translation of Fontenelle, 1688.

[1] Glanvill (J.), *Scepsis Scientifica, or Confest Ignorance the Way to Science*, edited by J. Owen, 1885, p. 157. Cf. *The Guardian*, no. 112, July 20, 1713. In the passage above quoted Glanvill goes on to imagine the possibility of some sort of telegraphic communication with the Indies superseding 'litterary correspondence'.

by his impatient though charming companion, with the remark that such ideas are mere 'raving', the philosopher calmly replies that 'there is somewhat more than Fancy, when it hath been already practis'd, for several have found the secret of fastening Wings, which bear them up in the Air, and from Steeple to Steeple'. Proceeding in terms of studied moderation, he admits that he 'cannot say indeed they have yet made an Eagles Flight, or that it doth not cost now and then a Leg or an Arm to one of these new Birds; but they may serve to represent the first Planks that were Launch'd on the Water. . . . The Art of Flying is but newly invented, it will improve by degrees, and in time grow perfect; then we may fly as far as the Moon'. Unconvinced by her mentor's prognostications, and doubtless realizing that the dangers suggested could not be confined to arms and legs, the countess retorts that, 'were you to live a thousand ages, I can never believe you will fly, but you must endanger your neck'. Though her ladyship's estimate of the time necessary to overcome the seemingly impossible has proved excessive, it is fair to add that the professor's earnestness prevails, and the countess having admitted her conversion to his arguments, the conversation turns to other aspects of the main subject.[1]

Sir Wm. Temple's Strictures on Flying, 1692.

It was not to be expected, however, that such 'airy speculations'—to use the apt phrase of Sir William Temple—should carry any general conviction, and Temple himself was not alone in treating these 'wondrous pretensions and visions of men'—'the art of flying till a man happens to fall down and break his neck', or 'the discoveries and voyages between this and that in the moon, to be made as frequently as between York and London'—with the mild scorn which is evident in his essay of *Ancient and Modern Learning*, 1692.[2] But ridicule, while it may deter, seldom destroys endeavours based on intense desire, and if the conquest of the air did seem a 'thousand years' away until after the middle of the eighteenth century, the idea was never abandoned, though it was destined to be suddenly achieved by a method which had hardly entered the minds of the learned, and was revealed to the people at large as a thing altogether unheard of.

[1] *A Plurality of Worlds*, translated into English by Mr. [J.] Glanvill, 1695, p. 59 et seq.

[2] Sir Wm. Temple's *Works*, 1814, vol. iii, pp. 516–17. Temple's name recalls a charming reference (about 1652) to the subject of aerial flight in the *Love Letters of Dorothy Osborne*, who is awakened to a sudden interest in the subject (as a means of rapid transport to her lover) on overhearing a conversation in which the speakers agreed that it was 'very possible' men might some day fly. (*Love Letters of Dorothy Osborne to Sir Wm. Temple*, by I. Gollancz, 1903, p. 163).

CHAPTER III

EIGHTEENTH-CENTURY CHEMISTS

THE DISCOVERY OF HYDROGEN AND INVENTION OF THE BALLOON

IT has been seen that the words of the sage in Bacon's *New Atlantis*—' We imitate also flights of birds '—represented for several centuries the general trend of thought on the subject of aerial navigation.[1] But the first success was achieved (as aforesaid) by a method wholly unlooked for, namely on the aerostatic or ' lighter-than-air ' principle. As a matter of fact the investigations into the nature of air and gases, carried out during the latter half of the seventeenth century by Galileo and Torricelli abroad, and in England by Boyle, Hooke, and Mayow, were leading up to the possibility of applying this method, the laws governing which were known to the early scientists from the writings of Archimedes.[2] Robert Boyle, with Hooke as his assistant, made numerous experiments in 1659–60 on the ' spring of the air '—its elasticity, compressibility, and weight—which led to his propounding the principle involved in the proportional relation between elasticity and pressure, still known as ' Boyle's Law '. In the course of these experiments—many of which were made with bladders and the improved air-pump Boyle invented—he noticed the effect of heat in causing the expansion of air. ' For we found ', he records, ' that a bladder but moderately filled with air and strongly tied, being awhile held near the fire, not only grew exceedingly turgid and hard, but afterwards being brought nearer to the fire suddenly broke with so loud and vehement a noise as stunned those that were near by '.[3] It was experiments such as these that led to the assertion, met with after the invention of the balloon, that Boyle's investigations ' on the weight of air gave birth to the new discovery of Montgolfier '.[4] Perhaps it would be more true to suggest that

Boyle's Experiments on Air, 1659–60.

[1] It is of interest to note that in the years immediately preceding Montgolfier's invention, J.-P. Blanchard was engaged on an elaborate ' heavier-than-air ' flying machine (see *post*, Ch. VIII, p. 161).

[2] John Mayow, or Mayo (1640–79), physiologist and chemist, made important contributions on the theory of combustion, as the result of experiments on the properties of air.

[3] Boyle (R.), *Works*, by P. Shaw, 1738, vol. ii. Cf. Thorpe (Sir T E), *Essays in Historical Chemistry*, 1902, p. 13, &c.

[4] *Morning Post*, Sept. 24, 1784.

when in 1739 John Clayton (1693–1773) made experiments with what he called 'spirit of coal', he must (in filling thick bladders with gas) have been very near to witnessing the phenomenon of the balloon.[1] But it was not until after the middle of the eighteenth century that the work of Cavendish, Black, Priestley, and Cavallo—to name the more distinguished chemists who worked in this country—resulted in discoveries which led directly to the invention of the balloon. As the subject has not hitherto been adequately dealt with, it is desirable to give some account of it before passing to the earliest practical results.

Henry Cavendish (1731–1810).

A foremost place in the chemistry of aerostation may be claimed for Henry Cavendish. Though the existence of inflammable air from metals (hydrogen) had been recognized long before the days of Cavendish, he was the first, not only to demonstrate the exact nature of it, but also the first to afford an approximate estimate of its density as compared with air, wherein lies the essence of his connexion with ballooning.[2] It was on reading the results of Cavendish's experiments on the specific gravity of hydrogen, that Black suggested for the first time the aerostatic principle of the balloon.

Henry Cavendish, the eldest son of Lord Charles Cavendish—himself a scientist of some distinction—was born at Nice in 1731. In due course he was entered at Peterhouse, but leaving Cambridge without taking a degree, he returned to his father's house, where he at once began the long series of mathematical, physical, and chemical studies which led to those important discoveries whereon his fame as a great chemist securely rests. Of an extremely shy and nervous temperament, Cavendish was equally reserved and taciturn, with the natural result that save for the passion—if the word be applicable to so passionless a man—of his scientific enterprises, his life was that of a recluse, both lonely and eventless. He took an active interest in the Royal Society, of which he became a Fellow in 1760, and of which his friend Sir Joseph Banks was elected President in 1778; but avoiding print almost as much as speech, his published scientific writings were confined—much

[1] See *Philosophical Transactions* for 1739, 'Experiments concerning the Spirit of Coals'. The application of coal gas to lighting purposes is generally believed to have been first applied by W. Murdoch (1754–1839), of Redruth, in 1792.

[2] The term 'inflammable air' was first used by Cavendish in his *Experiments on Factitious Air*, 1766. The name 'hydrogen' (now generally used) was substituted by Lavoisier about 1790.

like those of Cayley at a later date—to seven papers contributed to the *Philosophical Transactions* between 1766 and 1788. He died unattended at his house on Clapham Common on February 24, 1810.[1]

His Experiments on Hydrogen, 1766.

Cavendish's experiments on the specific gravity of hydrogen are recorded in the first part of his 'Three Papers, containing Experiments on Factitious Air', read before the Royal Society in May 1766. For the present purpose it is unnecessary to enter into the prolonged controversy which at this time raged round the theory of phlogiston—or 'principle of inflammability'—though that theory had an important bearing on Cavendish's researches into the character and properties of inflammable air obtained from metals (zinc, iron, and tin) on solution in acids (diluted vitriolic acid and spirit of salt). It must suffice to record that in his experiments he proceeded to ascertain the relative density of inflammable air compared with common or atmospheric air, subsequently repeating the experiments with hydrogen from other sources. The average of the trials showed that 80-ounce measures of inflammable air weigh 41 grains less than an equal bulk of common air, which, on the assumption that water is 800 times denser than air, would mean that hydrogen is seven times lighter than air, or taking Hauksbee's value of 850 for water, then eleven times lighter. Owing, however, to Cavendish's method being faulty in principle, his results were not precisely accurate, hydrogen being as a matter of fact fourteen and a half times lighter than air. But despite this error it may be justly said that Cavendish was the first to demonstrate the relative densities of hydrogen and air, and in using a bladder to contain the gas during his experiments he must have been even nearer than Clayton to witnessing a demonstration of the phenomenon of the balloon.[2]

His Researches on the Atmosphere, 1783.

At a later date, having published a memoir on *The New Eudiometer*, 1783, Cavendish undertook various analyses of common air, and in so doing his attention was drawn to aerostation, a subject in which he subsequently evinced some interest.[3] Doubtless such

[1] *Scientific Papers of the Honble. Henry Cavendish*, vol. ii, *Chemical and Dynamical*, edited by Sir Edward Thorpe, 1921, Introduction, p. 1 et seq. See also *D. N. B.*, vol. ix, p. 348.

[2] The original paper, as printed in the *Phil. Trans.*, vol. lvi, 1766, pp. 144–59, is illustrated with a plate of the apparatus used in these experiments.

[3] The eudiometer was used in Cavendish's time as a laboratory instrument for testing the purity of the air, or the quantity of oxygen it contains.

interest as he showed was primarily evoked, not by aeronautical considerations, but rather by reason of the fact that the invention afforded him an occasion for making calculations and physical measurements—an occupation Cavendish is known to have found congenial—and also because it gave promise of information on the nature of the upper air. On the occasion of Dr. Sheldon's ascent with Blanchard from Little Chelsea on October 16, 1784, Cavendish made observations on the altitudes and velocity of the balloon from the Royal Observatory, Greenwich. Undertaken in concert with Nevil Maskelyne (1732–1811), the Astronomer Royal, and Dr. William Heberden (1710–1801), the physician—characterized by Samuel Johnson as 'Ultimus Romanorum, the last of the learned physicians'—these observations were subsequently printed in Blanchard's *Journal* of the voyage, and are certainly the first of the kind made in England.[1]

His Observations on Blanchard's Balloon, Oct. 16, 1784,

About a month later, through the instrumentality of his friend, Dr. Charles Blagden (1748–1820), the secretary of the Royal Society—and to Johnson, 'a delightful fellow'—Cavendish lent Dr. Jeffries six phials in which to collect samples of the upper air during the ascent made by Jeffries with Blanchard on November 30, 1784.[2] Jeffries states in his *Narrative*—which was read before the Royal Society in January 1786—that two of the objects of his venture were to make observations on 'the state and temperature of the atmosphere at different heights from the earth', and to endeavour 'to throw some new light on the theory of winds in general'. For this purpose he took up 'a Thermometer; a Barometer; one of Nairn and Blunt's pocket Electrometers; an Hydrometer; one of Mr. Arnold's Time-pieces, and a Mariner's Compass', together with 'a very good telescope' and the phials above mentioned, the latter fitted with glass stoppers and filled with distilled water. These he emptied at different altitudes, and on his return to town sent them to Blagden, who passed them on to Cavendish.[3] The contained air was then analysed by Cavendish and compared with air taken at the window of his house in London,

and Analyses of the Upper Air obtained by Dr. Jeffries, Nov 30, 1784.

[1] The original manuscript of these 'Observations of the Altitude of Blanchard's balloon, 16 Oct. 1784, with Bird's Astronomical Quadr. at the Royal Observatory, 4 ft. radius', is preserved at Chatsworth. See Blanchard's *Journal* of his Fourth Voyage, 1784, p. 23. Also the *Scientific Papers of Henry Cavendish*, 1921, op. cit.

[2] See Ch. VII, p. 167.

[3] Jeffries (Dr. J.), *Narrative of Two Aerial Voyages with Mons. Blanchard*, 1786, p. 13.

the tests—apart from their scientific value—being of interest as the first scientific analyses of the upper air of which there is any record.[1]

Dr. Joseph Black (1728–99)

It was Cavendish's announcement as to the specific gravity of hydrogen, made in 1766—nearly twenty years before the balloon became a *fait accompli*—that led Joseph Black to make the suggestion by reason of which he is most nearly associated with the invention of balloons. Black was born at Bordeaux in 1728, his parents being of Scottish descent. His early education was undertaken at Belfast, and having studied chemistry under William Cullen at Glasgow University, he subsequently practised in the medical profession. As Professor of Anatomy and Chemistry at his Alma Mater between 1766 and 1793, he earned a unique reputation as a teacher, having previously published in 1761 his famous discovery of 'latent heat'. He is said to have had all the faculties for invention, but to have lacked fervour and determination to keep them at work. Probably his deficiency in such powers, combined with declining health in later years, deprived him of the honour—as is still sometimes claimed for him—of being the inventor of the balloon. It will be seen, however, that Black himself made no pretensions on the matter, and his suggestion that bladders filled with inflammable air would rise in the atmosphere, though theoretically 'obvious'—to use his own expression—was not tested further, at the most, than as an entertaining experiment.

His Aerostatic Suggestions, 1766.

His own account is to be found in two letters on the subject of aerostation, written in October and November 1784 in reply to Dr. James Lind (1736–1812), the Scottish scientist and inventor of an early type of anemometer, who was at this time living in Windsor as physician to the Royal Household.[2] Lind had written asking Black to furnish him with particulars as to his experiments, and the name of 'the person that first discovered the true specific gravity of Inflammable air', for use by Cavallo in his *History of Aerostation*, on which the latter was at this time engaged. Black replied (on November 13, 1784) that in 1766, after reading the

[1] The scientific ascents of Gay Lussac in 1804 are generally quoted as the first of the kind. In 1802 Humboldt and Bonpland ascended Chimborazo (not, as is often stated, in a balloon) in order to make observations on barometric pressure, &c. See La Landelle, p. 253.

[2] According to Fanny Burney, Dr. Lind's 'taste for tricks, conundrums and queer things [made] people fearful of his trying experiments upon their constitutions'. (See Austin Dobson's edition of the *Diary*, 1904, vol. ii.) Lind is also mentioned by Cavallo (p. 152) in connexion with a letter from James Watt describing an aerostatic experiment made by Boulton in 1784.

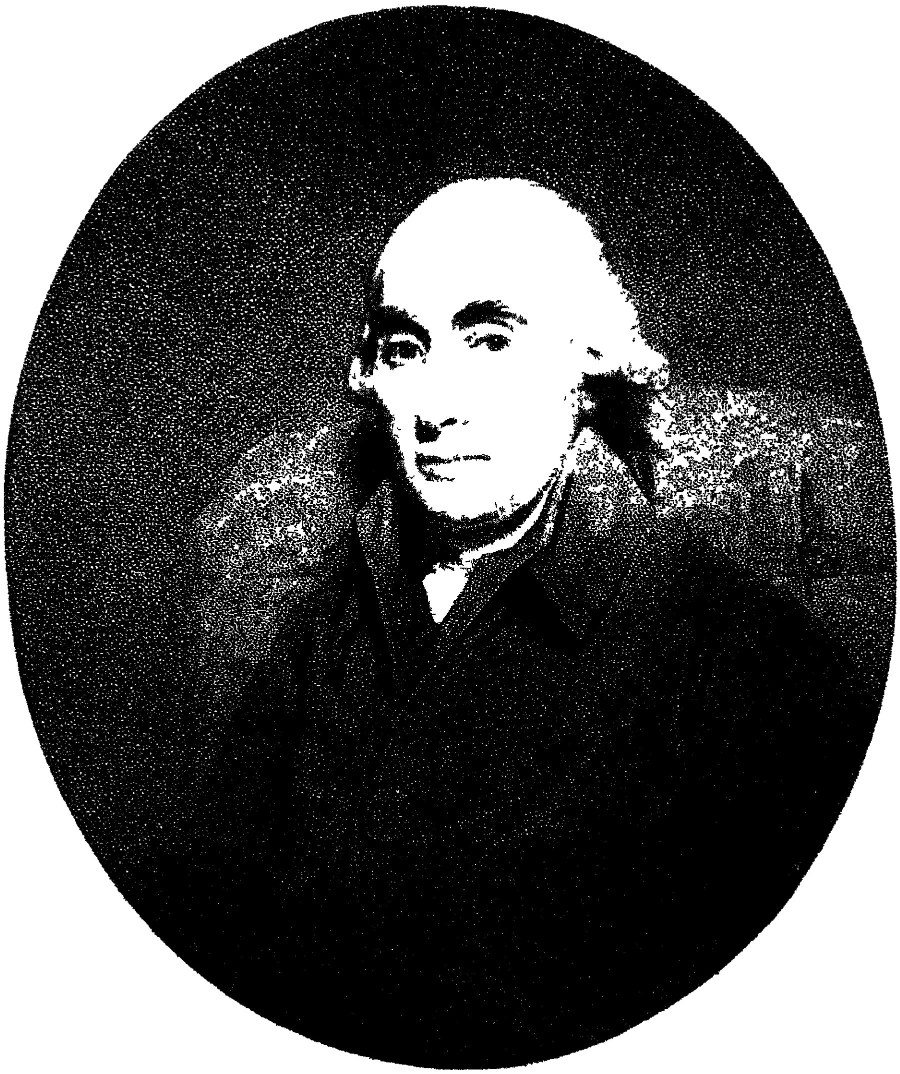


FIG 8 JOSEPH BLACK

Who first suggested that Bladders filled with Hydrogen would ascend, 1767–8

paper in which Cavendish gave the results of his experiments on the specific gravity of hydrogen, it occurred to him 'as an obvious consequence of Mr. Cavendish's discovery, that if a sufficiently thin and light bladder were filled with inflammable air, the bladder and contained air would necessarily form a mass lighter than atmospheric air, and which would rise in it'.[1]

'This', he wrote, 'I mentioned to some of my friends, and in my lectures the next time I had occasion to speak of inflammable air, and of Mr. Cavendish's discoveries, which was either in 1767 or 1768. I thought it would be an amusing experiment for the student; I applied to Dr. Munro's Dissector to prepare for me the allantois of a calf.[2] The allantois was prepared, but not untill [sic] some time when I was engaged with another part of my course, and did not chuse to interrupt the business then going on, so I dropped the experiment for that year, and in some of the subsequent years I only mentioned it as an obvious and self-evident consequence of Mr. Cavendish's discovery, but never made the experiment, which I considered merely amusing.'

The greater part of this actual letter was subsequently printed by Cavallo in his *History*, but with slight variations, the last sentence (after the word 'discovery') reading:

'but finding generally some difficulty in providing an allantois at the proper time I never made the experiment, which I considered as merely amusing. About two months ago I was informed, by a gentleman in the south of Ireland, that he had tried it, and that it succeeds perfectly well.'[3]

In the second letter (dated December 2, 1784), Black dealt more fully with the whole matter.

'As you speak of the *birth* of aerostatic experiments, I beg leave to communicate to you more fully my thoughts on that subject. In the first place, although what I have already informed you of is strictly true, I by no means set up my claim for merit in the invention of machines for general flights and excursions. The experiment with the bladder, which I proposed as a striking example of Mr. Cavendish's discovery, was so very obvious that

[1] Ramsay (Sir W.), *Life and Letters of Joseph Black, M.D.*, 1918, pp. 77 et seq.

[2] Alexander Monro (1733–1817) was at this time Professor of Anatomy in Edinburgh University.

[3] See Cavallo, p. 33. The variations are presumably accounted for by the fact that Cavallo quoted from the original letter, whereas Sir Wm. Ramsay (op. cit., pp. 3 and 38) used Black's own drafts preserved (with letters to Black) by a descendant. MacSweeny (p. 76) also refers to the anonymous experiment made in Ireland, as 'the first in the British dominions'.

any person might have thought of it; but I certainly never thought of making large artificial bladders, and making these lift heavy weights, and carry men up into the air. I have not the least suspicion that this was thought of anywhere before we began to hear of its being attempted in France, and I do not doubt that what has been published in the newspapers is perfectly true, viz., that Mons. Mongolfier (*sic*) had sometime before conceived the idea of flying up into the air by means of a very large bag or balloon of common air, simply rarifyed by the application of Fire of Flame.

'The idea being founded upon a principle which has long been known, and which has no connexion with Mr. Cavendish's discovery, it is only surprising that Mons. Mongolfier should not have put it sooner in practice. I suppose therefore that though he might have formed the Project a long time before, he never was roused into an operation for making the trial until others began to think of flying by means of Inflammable Air. Who first thought of the method I cannot tell, for I confess I did not read the history of these Experiments; they never interested me in the least.

'The hope that means might be discovered for moving these machines at pleasure and directing their course could only be formed by those who did not consider and understand their nature. The only circumstance which enables them to subsist in the air, however brisk the wind may be, is that, as soon as they rise, they are in effect perfectly becalmed; I mean that there is not the least perceptible motion or impulse of the air against any part of them; this is perfectly evident from their situation. They float in mid air, and have no hold on anything else; the air must therefore carry them along with a velocity equal to its own. The machine of itself can make no resistance, but while it moves along with the air, it cannot feel any motion of the air against it in any direction. It must therefore be in effect a dead calm; the motion of it cannot be perceived by those who are carried by it, except from the apparent motion of the objects on the surface of the earth, which seem to slide away from them; this tranquillity of the air with respect to them is one circumstance which contributes to that composure of mind which many of those feel who mount with balloons. I can imagine, however, that in a hot climate, when the weather is perfectly calm and the sun shining bright, a large balloon ascending with considerable velocity may occasion a whirlwind and be involved in it, which may be attended with dangerous consequences to those who accompany it. And this among other things shews the folly of attempting to give it motion at pleasure, or to command its motion or direction when it is up in the air; for besides the impracticability of finding a power that can be applied to produce this effect, although the power were found, any attempt to make use of it would destroy the balloon by impelling it against the air, and exposing it to such shocks and violence as it cannot bear; and further, in attempting to use such a power, it must necessarily happen, on account of the great surface of the balloon, and the resistance the air would make to its motion thro it, that the men and machinery by which it were moved must necessarily go foremost, and the

large bladder, etc, would be dragged after them in a horizontal direction, which would require an apparatus totally different from what has already been contrived.'[1]

His Alleged Experiment (1771).

Sir William Ramsay has suggested that Black's modesty led him to belittle his own claims, and in support quotes the incident recorded by Thomas Thomson (1773–1852)—Black's successor in the Glasgow Chair of Chemistry—in his *History of Chemistry.*[2] The story runs as follows:

'There is an anecdote of Black which I was told by Mr. Benjamin Bell of Edinburgh, author of a well-known system of surgery, and he assured me that he had it from the late Sir George Clarke of Pennicuik, who was a witness of the circumstance narrated. Soon after the appearance of Mr. Cavendish's paper on hydrogen gas, in which he made an approximation to the specific gravity of that body, showing that it was at least ten times lighter than atmospheric air, Dr. Black invited a party of his friends to supper, informing them that he had a curiosity to show them. Dr. Hutton, Mr. Clarke of Elden (*sic*), and Sir George Clarke of Pennicuik (*sic*) were of that number. When the company invited had assembled, he took them into a room. He had the allantois of a calf filled with hydrogen gas, and upon setting it at liberty, it immediately ascended and adhered to the ceiling. The phenomenon was easily accounted for: it was taken for granted that a small black thread had been attached to the allantois, that this thread passed through the ceiling, and that some one in the appartment above, by pulling the thread, elevated it to the ceiling, and kept it in this position. This explanation was so probable, that it was acceded to by the whole company; though, like many other plausable theories, it turned out wholly unfounded; for when the allantois was brought down, no thread was found attached to it. Dr. Black explained the cause of the ascent to his admiring friends; but such was his carelessness of his own reputation, and of the information of the public, that he never gave the least account of this curious experiment even to his class; and more than twelve years elapsed before this obvious property of hydrogen was applied to the elevation of air-balloons by M. Charles, in Paris.'[3]

Thomson's story of this incident—which it will be noticed is related as having occurred 'more than twelve years' before the first experiment by Charles in 1783—sounds sufficiently circumstantial to warrant belief. On the other hand, Black's own specific

[1] Ramsay's *Life of Black*, p. 79. Cf. *Monthly Mag.* for Sept. 1824, where this letter (with verbal differences) is printed in full. It is worthy of note that Faujas de Saint-Fond (*Journey through England*, vol. ii, p. 235, as referred to on p. 98 of this chapter) when recording several visits to Black in Edinburgh in October 1784, makes no mention of aerostation.

[2] Thomson (T.), *History of Chemistry*, two vols., 1830–1.

[3] Ramsay's *Life of Black*, p. 82.

statement—albeit set down in 1784—that although the idea of a bladder filled with hydrogen rising in the air had occurred to him in 1766, he never actually made the experiment, cannot be disregarded. There it would seem the matter must rest—unless, indeed, some confirmation of Thomson's story can be found, or other facts are revealed in any unprinted letters from Black which may be extant.[1]

Tiberius Cavallo (1749–1809).

In any case it is evident that Black's suggestions prompted the minor aerostatic experiments undertaken by Tiberius Cavallo in 1782, though in neither case should the significance be unduly stressed. Born in Naples in 1749, Cavallo was sent to England in 1771 to obtain experience in commercial affairs, but he soon gave up all business in order to devote himself to scientific studies and never returned to his native country. He was admitted as a fellow of the Royal Society in 1779, and having published several essays on electricity and magnetism (all written in English), he produced in 1781 his *Treatise on the Nature and Properties of Air*. It is in this book, when describing an experiment made 'to produce inflammable Air', that he incidentally records—apparently for the first time—the filling of soap-bubbles with hydrogen as a pleasing spectacle. Early in the next year, as the result of his previous researches, he attempted the experiment of constructing a vessel which, when filled with inflammable air, would ascend into the atmosphere. On June 20th he read before the Royal Society an account of the results, an exact copy of such part as related to aerostation being subsequently printed in his *History*.[2] The latter being a somewhat rare book, and Cavallo's experiment at this period being of peculiar interest, it may be useful to quote the paper *in extenso*. It is entitled

His Aerostatic Experiments, 1781.

'*An Account of Experiments relating to the property of common and inflammable air pervading the pores of paper.*

'It has been commonly believed, that common air would not pervade the pores of paper, such as is used for common printing, or writing; and, that paper is permeable to water, and not to air, has been alleged by some persons as an instance tending to prove, that some fluids have the property of passing through certain substances, and others have it not; although the particles of the former are of a grosser, heavier, or more tenacious nature towards each other.

[1] Since writing the above, Sir Edward Thorpe has pointed out to the author that many of Thomson's personal anecdotes have been shown to be untrustworthy, and that Black's own account is therefore to be preferred.

[2] See Cavallo, pp. 34 et seq.

FIG 9 TIBERIUS CAVALLO
Who first expeiimented with Hydrogen-inflated Bladdeis and Soap-bubbles, 1781

'Admitting, according to the common notion, this impermeability of paper to common air, and presuming that it was impervious to other permanently elastic fluids also, I determined to make use of paper for an experiment; which, though repeatedly attempted with other substances, had never succeeded. The experiment was to construct a vessel, or sort of bag, which, when inflated with inflammable air, might be lighter than an equal bulk of common air, and consequently might ascend, like smoke, into the atmosphere; it being well known, that inflammable air is specifically lighter than common air.

'The weight of inflammable air, the mean weight of atmospheric air, and the weight of the substance of which the vessel is to be formed, being ascertained; it is easy thence to determine by calculation the dimensions of a vessel, which, when filled with inflammable air, might be lighter than an equal bulk of atmospheric air. In this manner, and for the above mentioned purpose, I tried bladders, the thinnest and largest that could be procured. Some of them were cleaned with great care, removing from them all the superfluous membranes, and other matter, that could be possibly scraped off; but, notwithstanding these precautions, the lightest and largest of these prepared bladders being gaged, and the requisite calculation made, it was found, that, when filled with inflammable air, it would at least be ten grains heavier than an equal bulk of common air, and consequently it would descend, instead of ascending, in that element—Some swimming bladders of fishes were also found too heavy for the experiment; nor could I ever succeed to make any durable light balls by blowing inflammable air into a thick solution of gums, thick varnishes, and oil paint. In short, soap-balls, inflated with inflammable air, were the only things of this sort, that would ascend into the atmosphere; but as they are very brittle, and altogether untractable, they do not seem applicable to any philosophical purpose.

'As various of my acquaintances, in attempting to make such soap-balls with inflammable air, have not succeeded, it seems not improper briefly to subjoin, in this place, the mention of those particulars, which may facilitate the performance of this diverting experiment.

'The method by which I am more certain to succeed in this experiment, is—first, to introduce the inflammable air into a bladder that has a glass tube tied to its neck. For this purpose a perforated cork is adapted to a bottle, containing the materials which produce the inflammable air; then the glass tube of the bladder is thrusted into the perforation of the cork; but previous to this operation, the common air must be expelled as much as possible. Thus the inflammable air, as it is yielded by the materials in the bottle, enters and swells the bladder. The glass tube of the bladder should be about five or six inches long, its apperture should not exceed one tenth of an inch in diameter; the substance of the glass should be rather thick, and the extremity of it must be made very smooth, by means of a lamp and a blow-pipe; for if the tube has any sharp edges it is almost impossible

to make any soap-balls with it—Secondly. When the bladder is full of inflammable air, its neck is compressed just below the extremity of the glass tube, in order to prevent the escape of the inflammable air, and the glass tube is withdrawn from the cork of the bottle. Now the end of this tube, being dipped into a thick solution of soap (Windsor soap answers very well), the neck of the bladder is loosened, and by compressing the bladder, the inflammable air is forced out of it, and it makes a soap-ball, which when it becomes of about two or three inches in diameter, if disengaged from the glass tube, by gently shaking it, will ascend into the air, and will break against the ceiling of the room. When one soap-ball has been made, the neck of the bladder is immediately pressed, to prevent the loss of inflammable air; the end of the tube is dipped again into the solution of soap, and another ball is made. Thus with a large ox bladder, full of inflammable air, more than twenty soap-balls may be made, provided the experiment is performed with care.

'As the soap-balls are much more brittle when made with inflammable, than when made with common air, great attention should be had to avoid all the causes, which may occasion them to break; on which account the experiment should be performed in a room wherein the air is agitated as little as possible. The soap-ball must be made by very small degrees; viz, by compressing and letting the inflammable air out of the bladder very slowly. The extremity of the glass tube should at first be kept inclined downwards, and then should be gradually turned upwards, because those soap-balls are at first heavier than common air, hence they tend downwards; but, when they are become of a certain size, they become lighter than an equal bulk of atmospheric air, and turn gradually upwards; in which case, if the glass tube is not turned upwards also, the soap-ball soon breaks.—Thus far of the construction of soap-balls lighter than air.

'Amongst various attempts for the performance of the above mentioned experiment, I thought of trying paper; by means of which, it seemed that a vessel or bag might be easily made, which, when filled with inflammable air, would be lighter than common air. Accordingly, having procured some fine China paper, its weight was ascertained, and, after making the necessary calculations, a vessel or bag of a cylindrical shape, terminated by two short cones, was made of such dimensions, as, when inflated with inflammable air, it must have been lighter than an equal bulk of common air, by at least twenty-five grains; consequently it must have ascended, like smoke, into the atmosphere.

'After trying this paper vessel by inflating it with common air, the usual mixture of iron filings, and diluted vitriolic acid, for the production of inflammable air, was put into a large bottle; and, by means of a glass tube adapted to the neck of the bottle, and likewise to the aperture of the paper bag, which was suspended over the bottle, and out of which the common air had been expelled by compression, the inflammable air, as soon as it was produced, was made to enter the vessel; but I was surprised to observe,

that, notwithstanding the production of inflammable air was very copious, the paper vessel was not inflated in the least, and the smell of the inflammable air in the room was very strong. Suspecting that a hole in the paper might give exit to the inflammable air, the whole apparatus was attentively examined, the effervescing mixture was renewed, and every precaution, I could think of, was taken; but, after all, nothing else could be concluded, but that the inflammable air passed through the pores of paper, just like water through a sieve. After this observation it was necessary to examine that property with more accuracy, and by more decisive trials; and for this purpose the following experiments were made, etc.'

But though each one of Cavallo's hydrogen soap-bubbles was, in his own phrase, 'the first sort of inflammable air balloon' ever produced, his experiments—which he gave up as being 'tired with the expense and loss of time'—did not carry him further on the path leading directly to the discovery of the balloon as the first practical method of aerial navigation.[1]

His *History of Aerostation*, 1785.

It was natural, however, in view of his researches, that in the early days of the invention Cavallo should interest himself in its developments, his *History and Practice of Aerostation* being one of the first, as it was certainly the most important account of the subject published in England.[2] In the first and historical part of the book, having briefly surveyed the earliest recorded references to flight—with a more particular account of Bishop Wilkins's 'vague discourse'—Cavallo explains the physical basis of the new discovery. This is followed by a relation of the more interesting experiments and ascents so far made in France, Italy, and England—a contemporary record by a scientific writer, which must be accepted as in the main a trustworthy account. The actual discovery is attributed chiefly to Etienne Jacques Montgolfier, the younger of the two brothers, though later research has shown it was in reality to Joseph Michel, the elder, that the honour is primarily due.[3] In recording the experiment in Paris on October 15, 1783, when Pilâtre de Rozier first ascended in a captive Montgolfière balloon,

[1] There is no ground for suggesting that the claims of Black and Cavallo have ever been advanced to the point of depriving Montgolfier of the 'laurels attaching to the invention of the air balloon'. Cf. Hildebrandt (A.), *Airships Past and Present*, 1908, p. 9.

[2] In a letter in the Patent Office Coll., dated Oct. 14, 1784, Cavallo expresses his intention of being present at Blanchard's first ascent in London, made two days later. Faujas de Saint-Fond records that Cavallo 'translated into English with notes and comments, all that had been written in France on that astonishing discovery' of balloons. See his *Journey through England* (vol. i, p. 24) cited at p. 98, n. 1.

[3] Tissandier, vol. i, p. 6. Cavallo (p. 43) erroneously refers to Joseph as John.

and thus demonstrated 'to the world the accomplishment of what had been for ages desired and attempted in vain', Cavallo justly reflects on the sensations of this first 'pilot' of an intrepid race, as he gazed from aloft on the scene unfolded beneath him—reflections which, to use his own studied phrase, 'can hardly prevent an unusual sublime idea in ourselves'. On the other hand, he writes a little scornfully of Lunardi's first ascent in London—doubtless the profusion of 'romantic observations' in the aeronaut's own account of his adventure, and contrariwise the lack of any philosophical ones, were displeasing to the scientist, who was, moreover, clearly and quite rightly sceptical as to the claims made by Lunardi that he descended by means of his oar. The two voyages which appeared to Cavallo to be the most remarkable were that made by the Brothers Robert in their second cylindrical balloon, on September 19, 1784, and the Channel-crossing by Blanchard and Dr. Jeffries—the former being characterized as 'the longest and the most interesting' made up to that time, the latter as one deserving 'to be long remembered'. One statement by Cavallo calls for remark, in that, if correct, it robs James Sadler of the honour of being the first Englishman to ascend in a balloon. Referring to the newspaper reports that 'one Mr. Sadler' had ascended from Oxford 'with a rarefied-air balloon' on October 4, 1784, Cavallo states that 'after strict enquiry, it was found that nobody saw him either ascend or descend'.[1] But while admitting the credit due to Cavallo's denial, both by reason of the nearness of the event and the fact that Sadler was alive when the *History* was published, nevertheless there is reason for doubting its accuracy, as will be shown in the subsequent chapter on Sadler's achievements.[2]

Cavallo's denial of Sadler's Ascent on Oct 4, 1784.

A recapitulation of the more important facts as to the new art and its advantages and possibilities—points which Cavallo discusses with obvious interest and considerable acumen—is followed by a second part in which the 'Practice of Aerostation' is more fully discussed. Suffice it to say that the principles, capacity, construction, and power of 'aerostatic machines', the 'various means, either used or proposed, for raising higher, or lowering, and likewise for directing them', and the manner of filling them, are scientifically treated.[3] The sixth chapter affords suggestions as to 'Experiments

[1] See Cavallo, p. 176. [2] See Ch. VI, p. 142.

[3] Fig. 10. Cavallo (p. 217) recommends as the best method of producing inflammable air, the one then commonly used, viz.: turnings of iron or zinc dissolved in diluted vitriolic acid contained in wooden casks.

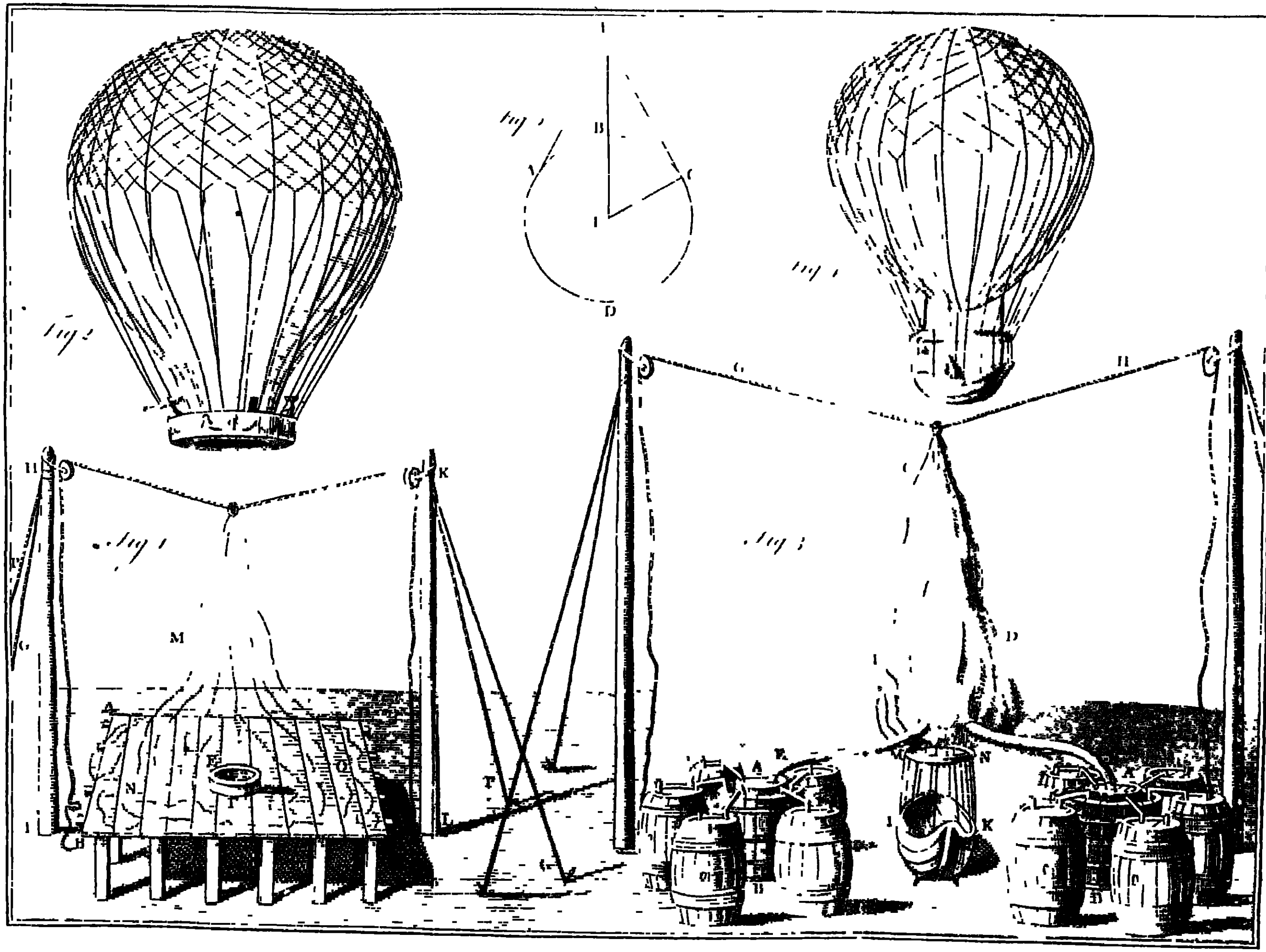


Fig 10. HOT-AIR AND INFLAMMABLE-AIR BALLOONS.

From Cavallo's *History of Aerostation*, 1785.

and observations proper to be made in the course of an aerial voyage ', while in conclusion Cavallo speculates on the uses to which aerostation may be applied.[1]

Joseph Priestley (1733–1804).

Cavallo's greater contemporary, Joseph Priestley—called by Cuvier a ' father of modern chemistry . . . who would never acknowledge his daughter '—though not so directly interested in aerostation, must always be associated with the discovery of the balloon, if only because Montgolfier admitted his indebtedness to this great English chemist, for ideas derived from his *Experiments and Observations on Different Kinds of Air*, 1774.[2] Though it is said that Priestley's experimental work on gases was inspired by the researches of Black and Cavendish, his own contributions include the independent discovery in 1774 of what he termed ' dephlogisticated air ', or oxygen, as it was afterwards called by Lavoisier. That Priestley was interested in assisting the earliest aeronauts in England in the matter of obtaining hydrogen, is evidenced in a letter from Richard Price—the political and economic writer—to his friend Benjamin Franklin, which relates that Priestley had ' discovered a method of filling the largest balloon with the lightest inflammable air in a very short time and at a very small expense '—two factors which gave the pioneers of ballooning considerable trouble, and which it was very desirable to overcome.[3]

His Method of obtaining Hydrogen, 1784.

This process Priestley himself explained to Faujas de Saint-Fond—allowing him to take a drawing of his apparatus for the benefit of French chemists working at the subject—when the French scientist visited him near Birmingham in the autumn of 1784. The ' simple and ingenious ' apparatus was described by Faujas (in his narrative of ' A Journey through England ') as

[1] Cavallo published further remarks on aerostation in the fourth volume of his *Elements of Natural Philosophy*, 1803.

[2] Five additional volumes were published between 1775 and 1786, and the French translation appeared in 1776. Montgolfier's admission appears in a paper he read before the Academy at Lyons, in Nov. 1783. See Hatton Turnor, p. 40, and *I. L. A.*, p. 508.

[3] The letter (dated Oct. 21, 1784) is in a volume of Ballooning Prints, &c, in the British Museum, collected by Miss Banks, daughter of the naturalist (press-mark, 1890, e. 15). In a letter to Black, Lind also refers to Priestley's new method, i. e. by passing steam over heated iron. See Ramsay's *Life of Black*, p. 77. It is possible that Priestley assisted in the inflation of Harper's balloon at Birmingham in Jan. 1785 (q.v. Ch. VIII, p. 193), and that he is referred to in *The Ballooniad* in the lines :

> Ye Men of Science ! how ye stood aloof,
> Nor gave of all your Knowledge one kind proof,
> Save two—whom gen'rous thanks attend,
> The peevish Chemist and his worthy friend.

a tube, thick and long, made of copper and cast in one piece to avoid joints.

'The part exposed to the fire', he continues, 'was thicker than the rest. Into this tube [Priestley] introduced filings or slips of iron, and instead of dropping in the water, he preferred making it enter as vapour. The furnace destined for this operation was heated with coke made from coal, the best of all fuels for the intensity and equality of its heat. By these means he obtained a considerable quantity of inflammable gas of great lightness and without any smell. He observed to me, that by increasing the apparatus and using iron or copper tubes of a larger calibre, aerostatic balloons might be filled at small expense and without the trouble and cost involved in the use of vitriolic acid.' [1]

Dr. G. Fordyce (1736–1802).

The name of one other chemist, that of Dr. George Fordyce, completes the link with the actual introduction of the balloon into England, inasmuch as Fordyce offered both scientific and practical assistance to Lunardi, on the inflation of his balloon for the first ascent in London.[2] On that account he deserves mention, rather than by reason of such contributions as he made (during a period of nearly thirty years as a lecturer on chemistry) to the current knowledge of heat and gases. As a matter of fact, Fordyce's first attempt to inflate a balloon was not (as will be seen in a later chapter) wholly successful, though how far this was due to his inexperience or the carelessness of his helpers cannot be known. It is said that when at midnight on September 14 he left the Artillery Ground to snatch a few hours sleep, the workmen he left in charge of the gas-making apparatus got drunk, so that Fordyce on returning at four o'clock in the morning, found nothing further had been accomplished—a *contretemps* which might have had disastrous consequences, and which actually did cause Lunardi much distress.[3]

Inflates Lunardi's Balloon, Sept 15, 1784.

[1] Faujas de Saint-Fond (B.), *Journey through England and Scotland in 1784*, translated, with notes, by Sir A. Geikie, Glasgow, 1907, vol. ii, pp. 351–2. Faujas, though chiefly distinguished as a geologist, was the author of one of the most important early works on aerostation (see Appendix III, Bibliography, p. 389).

[2] See Lunardi's account of the *First Aërial Voyage*, 1784, pp. 20 and 25.

[3] According to Samuel Rogers (*Table Talk*, 1856, p. 23), Fordyce himself was not above suspicion. On one occasion, having been called to the bedside of a lady, he found himself quite incapable of counting his patient's pulse and muttered to himself *sotto voce*, 'Drunk, by God!' His fears as to the result of such unprofessional conduct were unexpectedly allayed the next morning on receipt of a letter from a lady enclosing a banknote for £100, and expressing the hope that profound secrecy might be preserved as to her unfortunate condition overnight! Cf Boswell's *Johnson*, by Birkbeck Hill, 1887, vol. ii, p. 274.

Terms used in Connexion with the Discovery of the Balloon.

Before passing to relate the earliest aerostatic experiments made in England as the result of the Montgolfiers' discovery, it may be well to refer briefly to such technical words or expressions as the invention called into being. The word 'aeronautics', as now used in a general sense to describe the science of aerial navigation or flight—either by balloon, airship, aeroplane, or any other method—is probably the oldest generic term in English. As its Greek derivation suggests it was originally used to describe 'sailing' in the air, as a ship, rather than 'flight' as a bird.[1] Clearly there was very little occasion for any such word up to the end of the eighteenth century—some expression like the 'art of flying' was more common—and in the form 'aeronautica', it is contemptuously defined in Chambers' *Cyclopedia*, 1753, as 'the pretended art of sailing in a vessel through the air'. On the invention of the first, or 'lighter-than-air' method of aerial navigation, the French used the word 'aérostatique'—literally 'causing to stand in the air'—to describe the new art, with 'globe aérostatique', 'machine aérostatique', or simply 'aérostate', as applied to the balloon itself. These terms were naturally followed in England, and in the contemporary reports of the earliest French experiments the terms 'aerostat' or 'aerostatic machine'—which Cavallo called the 'general appellation of the flying instruments'—first appear, to be followed shortly by the improperly formed 'aerostation', to denote the art of navigating the air in machines of the Montgolfier type.[2] But the word 'balloon', especially with a prefix as 'air-balloon' or 'fire-balloon', was employed at least as early as 'aerostat', and soon came into more general use. As a matter of fact a much earlier use of these forms has caused some confusion—as far back as the middle of the seventeenth century, 'balloon' was used in pyrotechnics to describe the canvas or pasteboard receptacle made to contain rockets and stars, which burst in the air when fired from a mortar, such fireworks being known at a later date as

[1] Compare Flayder (F H), *De Arte Volandi*, Tubingen, 1628; Lana (F. de), *La Nave Volante (Prodromo*, cap. 6) Brescia, 1670; and Lohmeier (P.), *De Artificio Navigandi per aerem*, Rinthelij (1676). It may be noted that there are no quotations in the *Oxford Dictionary* under 'Flight' or 'Flying' bearing on the idea of human flight, not even in an imaginative sense.

[2] The *Oxford Dictionary* gives: Aerostation (2) 'The art of raising and guiding balloons or other machines in the air'. The earliest quotation given is from Cavallo's *History*, 1785. Faujas de St. Fond (vol. 2, p. 5) attributes to Montgolfier the first use of the term 'aérostat'. In English it is still used in the specifications of lighter-than-air machines drawn up for purposes of patent registration.

'air-balloons'.[1] As to that part of the balloon designed to carry the aeronauts, this was at first called a 'gallery' or 'chariot'—the former as applied to what was indeed in the form of a gallery, constructed round the lower part of a 'Montgolfière' or hot-air balloon, and the latter to the car suspended beneath a 'Charlière' or inflammable-air balloon. The word 'gallery' was used in descriptions of Lunardi's first ascent, but the designation was doubtless merely copied and was not wholly accurate, being superseded within a short time by the more appropriate words 'car' or 'basket'. It was also from the French 'aéronaute' that the English equivalent was taken to describe the occupant, the designation 'pilot' as used to-day, though occasionally found in the early French records, being introduced at a later period.

[1] See Bate (J.), *Mysteries of Nature and Art*, 1634 (Fier-Works: How to make Balloons). Cf. Florio (J.), *New World of Words*, 1598, 'Balloon, a great ball'. Also *Oxford Dictionary* under Air-Balloon (where the definition is in the aerostatic sense, but the first quotation illustrates the older pyrotechnic sense), and Balloon. Both forms, 'balloon' and 'balon', were also used in the eighteenth century for a globose glass vessel used by chemists in experimental work. See Harris (I.), *Lexicon Technicum*, two vols., 1708.

FIG. 11 Signed Admission Ticket for Biaggini's 'Aerostatick Globe', Nov. 10, 1783

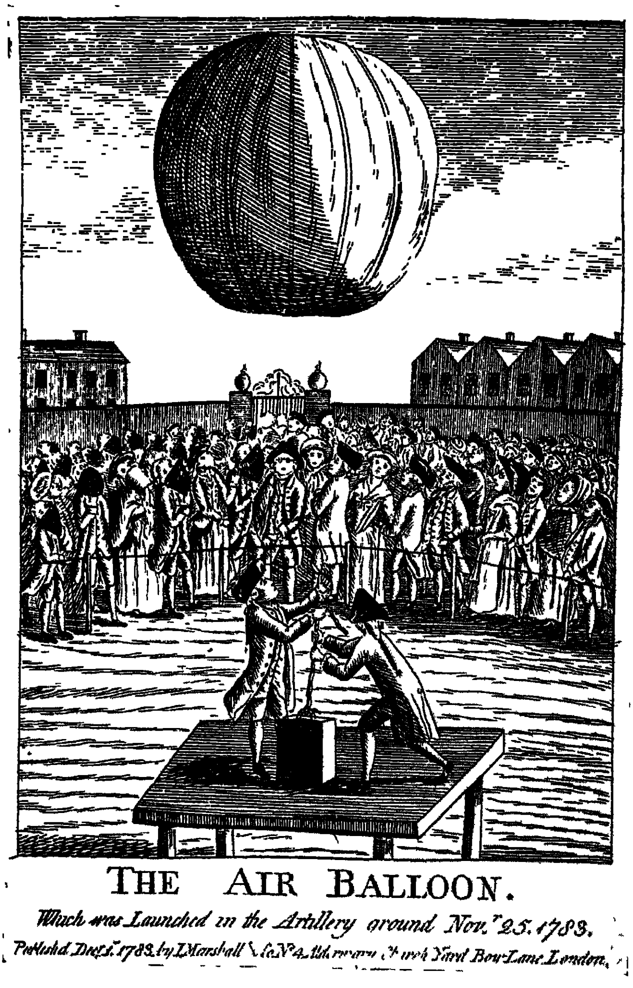


FIG. 12. Zambeccari's First Public Balloon Experiment, Artillery Ground, Moorfields, Nov. 25, 1783.

CHAPTER IV

EARLY AEROSTATIC EXPERIMENTS AND ATTEMPTED ASCENTS

As in France, where the first free ascent of Pilâtre de Rozier made from Paris on November 21, 1783, had been preceded by the release of experimental balloons, so in England the first successful ascent by Lunardi was heralded by previous experiments of a similar kind.[1] But the interval was of much longer duration, even taking into account the attempts made, by Tytler at Edinburgh, amongst others, which had they proved successful would have forestalled Lunardi.

Count Francesco Zambeccari (1752–1812).

There is little doubt that the earliest aerostatic experiment in England was made by Count Francesco Zambeccari, an Italian sailor of fortune. Born at Bologna in 1752, Zambeccari, having studied mathematics and the sciences at Parma, entered the service of the King of Spain, and was for some years employed in the navy in operations against the Moors and off the coast of America. In 1783 some indiscreet, perhaps some blunt sailor-like utterance, brought him into conflict with the Inquisition, with the result that he first fled to Paris and subsequently crossed to England as a haven of refuge. Greatly impressed by the experiments of Montgolfier with 'Flying globes' he determined to construct one himself, and having easily accomplished his object—as he tells later in a letter from London, dated November 28, 1783—he released his balloon from the house of a fellow-countryman, Michael Biaggini, in Cheapside, on November 4, 1783.[2] As Biaggini was a maker of artificial flowers, it is probable he assisted in the making of this 'aerostatic globe'—a small affair of only 5 feet in diameter—while Zambeccari himself acknowledges that

His First Aerostatic Experiment in England Nov. 4, 1783.

[1] By 'experimental balloons' is meant balloons—inflated either with hot air or hydrogen—sent up as an experiment without a pilot. It is generally admitted that the first living things to ascend beneath a balloon were the three animals suspended beneath Montgolfier's Versailles balloon on Sept. 19, 1783. Pilâtre de Rozier made his first captive ascent on Oct. 15 of the same year.

[2] *Il Mondo Illustrato*, 1847, vol. i, p. 599, &c. See also Boffito, ch. xv. Three days earlier Johnson told Mrs. Thrale that an 'air ballon (*sic*) has been lately procured by our virtuosi, but it performed very little to their expectation' (*Letters of S. Johnson*, by Birkbeck Hill, 1892, vol. ii, p. 347).

Biaggini contributed towards the cost of it. Though launched in private it attracted the mingled curiosity and wonder of the citizens of London, as it floated in the sky. From Highgate it was seen by large numbers, who hurried from their houses to witness this novel though diminutive aerial spectacle, the balloon being eventually picked up at Waltham Abbey.

Zambeccari's First Public Experiment with a Balloon, Nov. 25, 1783.

Encouraged by the widespread interest aroused, Zambeccari relates how he worked diligently—again, as there is reason to believe, with the help of Biaggini—at the construction of another 'hot-air' balloon, made of oil-silk and covered with gilt to serve at once the purposes of decoration and impermeability. It was just twice the size of his first balloon, measuring 10 feet in diameter, and when three-quarters filled with 'inflammable air' was computed to have a 'lift' of 16 lb. Having exhibited it at the Lyceum in the Strand (where it was inflated with common air) he launched it from the Artillery Ground in Moorfields on November 25th following, in the presence of a 'vast number of people' who had assembled to witness this first public exhibition of a balloon in London, indeed in England.[1] Two and a half hours later it descended at Graffam, near Petworth, in Sussex, a distance of forty-eight miles from London. It is said to have been found by a farmer, who with a ready enterprise (not always associated with English farmers) at once exhibited it in a local barn at a charge of one penny a head, thus reaping an unusual harvest by trading on the curiosity of the neighbouring folk. A few weeks later Biaggini made a yet larger balloon, 16 feet in diameter, capable (as was believed) of lifting a child of eight, while on December 18th a smaller 'air-balloon' was released by J. Dinwiddie, a lecturer in experimental philosophy, from the Bowling Green Tavern, near Buckingham Gate.[2] The latter was 9 feet long and 4 feet in circumference, resembling in its longitudinal form a 'pocket of hops', and it may be noted that to a contemporary observer the irregular motion of its ascent rightly suggested that the best form for a balloon 'should be circular, as it not only ascends higher but

[1] The Banks Collection in the British Museum (Print Department) contains an admission ticket—with an engraving of the 'Aerostatick Globe'—signed 'Michl. Biaggini, Nov. 10'. (Fig. 11). Possibly the experiment was postponed to the 25th.

[2] See *The Air Balloon*, 1783, pp. 22 and 35. Dinwiddie also sent up experimental balloons from Bath on Dec. 29, and Bristol on Jan. 24, 1784, while in the following February he gave a public lecture on air-balloons at Exeter. In 1785 he invented a four-wheeled carriage to be propelled by treadles, called 'Dinwiddie's Flying Chariot'.

Fig 13 ARGAND'S AEROSTATIC EXPERIMENT AT WINDSOR CASTLE
Nov 26, 1783

steadier '.[1] Meanwhile Zambeccari had determined to attempt a more ambitious scheme, as will be told later.

Argand's Experimen at Windsor Nov. 26, 1783.

An aerostatic experiment of more significance was that conducted at Windsor Castle, on the day following Zambeccari's first public exhibition, by Aimé Argand, the distinguished Swiss scientist, for the edification and amusement of King George III and the members of the Royal Family. The King had already evinced an interest in the discovery and had written early in October to Sir Joseph Banks, then President of the Royal Society, offering to defray the cost of experiments with air-balloons, if in the opinion of the Society any useful purpose could be served thereby. But the matter was dropped, as the Council of the Society expressed the view that ' no good whatever could result '. The demonstration by Argand was of the simplest kind, the balloon being only 30 inches in diameter, filled with hydrogen by means of ' un fort joli appareil ' —as Argand himself describes the apparatus. In a letter to Faujas de Saint-Fond he gives a picturesque account of the affair—the King toying with the balloon at the end of a string, letting it rise to the Queen and the Princesses at the upper windows, and finally, when the cord had been cut, watching it for ten minutes until it disappeared from sight. The experiment afforded the King the utmost satisfaction, and Argand adds that he was invited to remain for two days ' au milieu de cette interessante Cour ', in order to give further exhibitions.[2]

Provincial Experiments, Jan.–Mar. 1784.

Early in the new year aerostatic experiments with air-balloons (usually filled with hydrogen) on the small scale of those made by Biaggini and Dinwiddie, took place throughout the kingdom. Amongst provincial towns which witnessed the ascent of these experimental balloons the following are on record : Manchester on December 26, 1783 ; Colchester and Derby, in January 1784 ; Oxford, Birmingham, Norwich (at Quantrell's Gardens), and Sandwich (when the balloon, only 4 feet in diameter, was blown across the Channel and subsequently found at Warneton, near Ypres), in February ; Aberdeen, in March, and Macroom, near Cork, in April.[3] At Oxford two experiments were carried out in

[1] *The Air Balloon*, 1783, p. 36.

[2] Faujas de Saint-Fond, *Description des Expériences Aérostatiques*, vol. ii, 1784, pp. 191–2. Two crude contemporary engravings (published by Basire) of this experiment, and of a ' Professor filling and explaining . . . a Baloon ', are reproduced by Bruel (nos. 124 and 125), who makes an amusing mistake in the descriptive text by naming the scientist, ' Professor Filling '. See also Fig. 13.

[3] The *General Advertiser* for Feb. 24, 1784, contains an account of the ascent of a balloon from Ross in Herefordshire, which took up a noted ' old English Jew Barber ', to a height of 115 feet. The story is not confirmed elsewhere.

February, both from the gardens of Queen's College. The first was conducted by James Sadler, who, destined to become the 'first English aeronaut', thus evinced his interest in ballooning at an early date, the balloon being afterwards found near Wrotham, in Kent; the second (on the 19th) by one named Rudge, whose balloon measured 16 feet in circumference, and was made of 22 yards of red and white varnished Persian silk.[1] Meanwhile the novelty of sending up small balloons both by day and night—the latter being generally miniature 'Montgolfières', that is with a flame beneath—became as universally popular an amusement in England as it had already become some months previously in France.[2] The trade of 'Balloon Maker'—engaged in by those dealing in umbrellas or other articles made of oiled silk or lawn—became a profitable one, and the 'whole process of constructing and filling' air-balloons was soon reduced 'to a scale of certainty', thus rendering them little more than adult toys.[3] But while the volume of popular interest increased, the active participation of scientists in this country flagged, and some months were to elapse before any determined attempt was made in England to construct a balloon capable of lifting an aeronaut.

Zambeccari's Proposed Balloon, Jan. 3, 1784.

It is true that on January 3, 1784, Zambeccari issued proposals for the construction of a large 'Aerostatic Globe', 50 feet in diameter, fitted with a machine for directing the globe (provided the wind did not exceed four miles an hour), inviting subscriptions towards the estimated cost of £800. Despite a further announcement (which appeared towards the end of February) that an ascent would be made from Hyde Park, the project fell through owing to the lack of financial support, and Zambeccari, a ruined man, left England for a time.[4] 'It is now almost twelve months', said a writer in the *Public Ledger*, as late as September 2nd of the same year, with a touch of reproachful sarcasm, 'since Montgolfier first ascended, yet England with all its learning, ingenuity and encouragement of the arts, has never been able to produce one John Bull who wishes to take an airing this way.' Lunardi himself remarked on the lack of interest shown by English scientists in the aerial voyages made in France, which they regarded 'with a silence and

[1] Cavallo (p. 128) refers to this balloon as the first seen in Oxford, but Sadler's experiment took place more than a fortnight earlier.

[2] See Cavallo, pp 135–6.

[3] The words quoted are from an advertisement of Allen Keegan (q.v., pp. 113–16).

[4] *Il Mondo Illustrato*, 1847, vol. i.

apparent indifference not easily to be accounted for '.[1] How far this may have been due to feelings antagonistic to an invention which had originated in France, or (as Cavallo suggested) to a persuasion that it was unnecessary to trouble in this country about experiments which the French were 'fully capable' of carrying out themselves, it is not easy to determine.

The Air Balloon, 1783.

It is at least certain that during the years following the invention of 1783, a far larger number of books on the principles of aerostation, both scientific and descriptive, were written in French than in English. A small anonymous volume entitled '*The Air Balloon: Or a Treatise on the Aerostatic Globe,* lately invented by the celebrated Mons. Montgolfier of Paris', which was published in London before the end of November 1783, has the merit of being not only the first book on the subject in English but one of the earliest in any language.[2] It contains, however, little more than an elementary statement of principles 'rendered familiar to the plainest capacity', and cannot compare with such books as Faujas de Saint-Fond's *Description,* published about the same time, Meusnier's *Mémoir sur l'équilibre des Machines Aérostatiques* of the year following, or many others. The treatise first explains, in language more simple than scientifically accurate, the properties of the air and the two methods of inflating a balloon, with some confusion in the case of 'hot-air' balloons as to the intrinsic levity of 'smoke'. The latter are described as being of greater utility than inflammable-air balloons, in that the pilot, by carrying fuel with which to feed the fire of wet straw, can 'ascend or descend at pleasure', whereas in the latter case—the idea of a valve, as invented by Charles, not being yet generally known—it must rise to a point at which it would burst, and consequently 'fall with such rapidity as to crush [the aeronaut] to pieces'. A short account follows of the ascent of Pilâtre de Rozier on October 19th, and of Zambeccari's experiment at the Artillery Ground, while some details are given of an improvement in the direction of controlling a balloon by means of wings or feathered oars. This

[1] As confirming Lunardi's view it is noticeable that the only papers on aerostation read before the Royal Society between 1783 and 1800, were those communicated by Sir J. Banks. The first was written by the Comte de Galvez, a Spaniard, but though entitled 'Sur un moyen de donner la Direction aux Machines Aérostatiques', it describes mainly the application of 'flapping' sails as a method of propelling a boat upstream, with suggestions as to adapting the device to balloons (see *Phil. Trans.*, vol. 74, 1785, and *European Mag.*, March 1785, p. 176). The second was the narrative of the two aerial voyages of Dr. J. Jeffries (see p. 167, *post*).

[2] For a note as to the authorship of this treatise see Appendix III, Bibliography, p. 400.

machine—'now in great forwardness under a Scotch artist, who is already supported by a subscription of seven hundred guineas to complete it'—is described as being in the form of a bird, the body

THE

AIR BALLOON:

Or a TREATISE on

THE AEROSTATIC GLOBE,

Lately invented by

The celebrated Monſ. MONTGOLFIER of Paris.

SHEWING,

Firſt—Thoſe Properties of Air, which influence an Air Balloon.

2dly—The particular Conſtruction and Methods of filling it.

3dly—Some of the great Variety of probable Uſes which this important Diſcovery may be applied to for the Benefit of Mankind.

The Whole rendered familiar to the plaineſt Capacity.

"To be impriſoned in the viewleſs winds,
"And blown with reſtleſs violence round about
"The pendent world."

SHAKESPEARE's Meaſure for Meaſure.

By Will Cooke Esq

LONDON.

Printed for G. KEARSLEY, N° 46, Fleet-ſtreet.

M DCC LXXXIII.

Fig. 14.

to be filled with inflammable air, with wings—'made of the purest elastic steel'—to be worked by the aeronaut from a basket attached to the machine.[1] Finally some considerations are offered on the

[1] Op cit. p. 24. cf. *Letters of S Johnson*, vol. ii, 1892, p. 372. In *The Oriental Chronicles of the Times* (an anonymous political record of the Westminster Election of 1784 in mock-scriptural style) there is a reference to a 'curious projector' named Holliday, a tailor of St. Thomas's, Southwark, who is said to have made a 'plumed garment' with which to fly. It is further suggested that the idea had been borrowed 'from the late celebrated Dr. Dekar, of Southwark, who is said to have first invented the Air Balloon'.

utility of the 'Air-Balloon'—its use for purposes of communication in case of invasion; for reconnaissance on the battle-field, in sieges, and a war of posts (Braddock's disastrous campaign in Albany in 1755 being cited in the latter connexion); for ascertaining the locality of fires and the more speedy summoning of assistance; for meteorological observations (on the lines of Franklin's experiments by means of kites), and lastly for affording to those suffering from 'asthmas and decays' the benefits of pure air at an elevation.[1] A postscript was subsequently added recording the ascent of Charles and Robert on December 1st, and in a third edition—which testifies to a popular demand for the treatise—published before the end of the year there are further additions.

Meanwhile the spring of 1784 brought forth several schemes which, to judge from their character, were probably inspired by the idea of turning to monetary advantage the prevailing interest in balloon ascents. A large air-balloon was announced in February as being constructed at Kew, capable of carrying two persons, while in May some unknown adventurer advertised the ascent of a 'Grand Aerostatic Pyramid' from Ranelagh Gardens, which ended in complete failure.[2] The first serious ballooning project in Great Britain was essayed in Edinburgh, and to James Tytler belongs the honour, albeit qualified by reason of only partial success, of being the first to ascend into the air in this kingdom.

James Tytler (1747–1804).

James Tytler was born about 1747, at Fearn in Forfarshire. Having decided to enter the profession of medicine and surgery he studied at Edinburgh under Dr. Black, and it is interesting to reflect that he may have gathered from the lips of that distinguished chemist the first hint of the phenomenon of the balloon. On the completion of his studies he made a voyage to Greenland as a ship's surgeon, but on his return he failed in the medical profession, and suffered sundry misfortunes in a career as chemist and hack-writer. In 1776 he was employed—it is said for the miserable pittance of 17*s*. a week—to edit the second edition of the *Encyclopaedia Britannica*, about three-quarters of which is credited to his pen. Subsequently he was engaged in editing the third edition, and on the invention of the balloon his scientific bent led him to

[1] Cf. Boswell's *Life*, by Birkbeck Hill, vol. iv, 1887, p. 358.

[2] It is possible that the so-called Chevalier de Moret was connected with this affair (see *post*, p. 111). A contemporary account of it refers satirically to the '*Monsieur*' running off with the '*argent comptant*'.

His First Ballooning Exploit, 1784.

take an interest in the subject. During July 1784 he constructed (with money obtained by subscription) a balloon on the 'hot-air' principle of the Montgolfiers, measuring 40 feet high by 30 feet in diameter, with which he essayed his first attempt in Comely Gardens, near the King's Park, Edinburgh, on August 7th. On the first inflation—according to the 'Short history of the Edinburgh Fire Balloon' written by Tytler himself, and printed in Lunardi's *Account of Five Aerial Voyages in Scotland*—owing to the 'gallery' (or car) beneath the balloon taking fire, the chains suspending the stove broke, and thus prevented any further attempt.[1] The next evening he again inflated the balloon, and although the gallery had not been repaired, Tytler was about to get into it, when a violent gust of wind beat against the balloon, driving out the 'hot air' and so far damaging it that again the attempt was postponed. Owing to the rough usage the 'envelope' had experienced, Tytler now found it necessary to remove the paper lining, and cover with varnish the cloth of which it was made. In this process he removed the gallery, and as it was impossible without it to carry the stove (which weighed nearly 300 lb.), he decided to inflate the balloon to the utmost and ascend beneath it 'like a log or piece of ballast'—a resolution which he realized was that of a madman'.[2]

His Ascent on Aug. 25, 1784.

At a later date—in the early morning of August 25th—the balloon, 'new varnished and very tight, was exposed to a very strong heat for nearly an hour', at the end of which time Tytler estimated that its power of ascension must have been nearly half a ton. What followed may best be given in Tytler's own words.

'The Balloon set off from the ground with the swiftness of an arrow, but could not ascend more than a few feet, when it was stopped by a rope belonging to the mast which held it up during the time of inflation. This broke its force very considerably, and even when freed from this, it flew

[1] Lunardi (V.), *Account of Five Aerial Voyages in Scotland*, 1786, pp. 107–22, note. The 'history' appears as a note to the verses addressed by Tytler to Lunardi, printed at the end of the book (pp. 105–14). A press cutting in the Cuthbert Collection, 'Extract of a letter from Edinburgh, Aug. 9', refers to the accident—'which hitherto has never failed to attend every proposed exhibition of this aerial machine'—and states that the disappointed mob seized the basket and burnt it to ashes.

[2] In Kay's *Original Portraits*, two vols, 1837–8 (no. 38), there is an etching with a view of Tytler's balloon, showing the car suspended a long way below the envelope. The balloon is also depicted on a ticket in the Banks Collection (British Museum Print Dept., see Fig. 15), which bears the words 'constructed by W. Brodie' struck through as if incorrect. The wood engraving of this ticket in the *Literary World*, vol. iii, 1840, p. 258, is misleading.

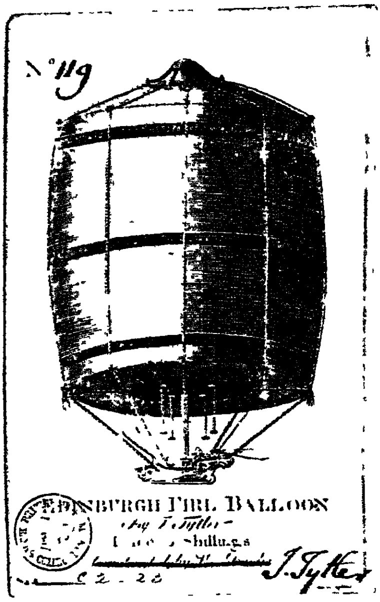


Fig. 15. Signed Admission Ticket for Tytler's
Fire Balloon, Edinburgh, Aug. 1784.

Fig. 16. A Group of Aeronauts: Lunardi (centre) and
Tytler (next to the left).
From Kay's *Original Portraits*, 1837–8.

with such rapidity that several of the spectators, terrified at the unusual sight, endeavoured to drag it downwards till the rope was forced from their hands. Thus my career was stopped, and I arose only a very small way, some say 350 feet, others 500. For my own part, I had scarce time to taste the pleasures of an aerial journey, and during the little time I was in the air, I amused myself with looking at the spectators running about in confusion below. My reception from the ground was much more rude than I expected, and though insufficient to *hurt*, was enough to *warn* me to proceed no more in this way.' [1]

Further Attempts on Sept. 1. etc.

On September 1st Tytler took what he calls 'another leap of the same kind', again without any stove, though with more caution, not inflating the balloon so fully and instructing his assistants to retard its ascension so that he might only pass over adjacent trees and houses. With renewed hopes of complete success—and doubtless urged on by the news of Lunardi's ascent in London on the 15th—he constructed a new gallery and stove, and announced a further experiment for September 29th. Misfortune still followed him, for despite the precaution of sheltering the balloon from the west winds which had caused trouble hitherto, it blew this day violently from the east, and carried away the mast from which the balloon was suspended during inflation, making any attempt impossible. With a pertinacity in the face of misfortune and ridicule which was certainly praiseworthy, Tytler determined to make a trial in private, in order to ensure success for the next ascent in public at the Comely Gardens on October 11th. But a crowd having assembled, he was urged to ascend, if only to refute the general impression that his refusal was due to cowardice, though he realized—the balloon, kept in a state of inflation for nearly two hours, having very little 'lift'—that 'the greatest hero on earth could not ascend at that time'. The want of levity was due partly to the substitution, at the urgent request of his friends, of a smaller stove, and partly owing to the defective condition of the balloon itself, from every pore of which the smoke (or 'hot air') was escaping. Equipped with a cork jacket, Tytler entered the gallery; but as the balloon failed to rise, he was obliged to get out again, and when left to itself the balloon—to quote the expressive phrase

[1] Lunardi, *op. cit.*, p. 109. A contemporary news-cutting (quoted, with an error as to date, in the *Ency. Brit.*, 11th ed., p. 264) records that he 'ascended very high, and descended quite gradually on the road to Restalrig, about half a mile from the place where he rose'. At the conclusion of this glorified version the writer magniloquently claims for Tytler the honour of being 'the first person to navigate the air in Great Britain'. Cavallo in his *History* makes no mention whatsoever of Tytler.

of a contemporary account—'rolled about like an overgrown porpoise', rose to a height of about 300 feet, and then fell sideways to the ground. Tytler's only consolation lay in the fact that the failure proved his advisers to have been wrong and himself right; otherwise he had to bear not only the unstinted abuse of the press, but also the insults of cheat, rascal, and coward, which were hurled at him wherever he went. Ignoring his detractors in silence, he still persevered; but having constructed a large stove, he was again prevented by tempestuous weather from making a renewed attempt.

Tytler's Last Attempt, July 26 1785

Further misfortunes ensued; his balloon was seized for damages, and Tytler involved in a lawsuit which, after lasting six months, resulted in a judgement against him. By the help of his friends he eventually recovered the balloon, and the summer having been spent in languid attempts to repair it, a final experiment was made on July 26th. Hardly had the fire been lighted, when a violent storm burst over the place of ascent, the balloon was torn from those who held it, the stove smashed in pieces, and the envelope badly damaged. This proved to be the end of the 'Edinburgh Grand Fire-balloon', for Tytler, 'overwhelmed by this series of disasters, abandoned the scheme in despair and took no further part in aeronautical endeavours. In 1792 he was obliged to flee to Ireland to avoid persecution for political offences, and three years later he crossed to America. Having settled in Salem, Massachusetts, he devoted himself to writing works on medicine and other scientific subjects, and though living the life of an eccentric recluse, he won considerable esteem for his learning. Misfortune pursued him, however, even in death, for he perished miserably at Salem, in January 1804, through drowning when in a state of intoxication.[1]

From Tytler's own words it seems clear that while it is true he was the first in Great Britain to ascend into the air, his success was of a very limited kind, and he received little credit for his endeavours. When Lunardi visited Edinburgh in September 1785, he expressly says that one of the attractions which drew him thither was the idea of being 'the first Aeronaut in Scotland', and at the end of his account of his *Five Aerial Voyages* he refers

[1] [Meek (R.)], *Biographical Sketch of James Tytler*, Edinburgh, 1805; Kay's *Portraits*, 1837–8, no. 38; *D. N. B.*, vol. lvii, p. 452. Cf. Hubbard (T. O'B.), 'The First British Aeronaut', in *Aeronautics*, vol. ii, July 1909. Some account of Tytler's life in Salem, and of his death, is given in the *Diary of Wm. Bentley* (1784–1819), four vols., Salem, 1905–14.

to Tytler's attempts to launch a large fire balloon, 'but all without success'. Doubtless the latter was at this time in the throes of intense disappointment and trouble, and it is to Lunardi's credit that he not only saw Tytler but apparently did what he could to alleviate his distress. As an acknowledgement of this kindness Tytler wrote some verses in Lunardi's honour, in which, generously applauding his rival's success, he also gave expression to his own mortification and sense of failure.[1]

Meanwhile Lunardi himself had taken steps as early as July to prepare for his own venture. But before entering on the story of his historic first ascent, it may be well to dispose of two ballooning projects, both of which ended in failure and destruction and the first of which caused Lunardi so much trouble and vexation.

During the month of January 1784 there appeared in the London press announcements of the construction 'by a society of skilful persons' of an aerostatic machine, 60 feet high, 95 feet in circumference, and with a capacity of 33,400 cubic feet, in the form of a 'Chinese Temple', the project being associated with the 'learned Chevalier de Moret, a genius for distinguished discoveries'.[2] Moret was refused permission by the Honourable Artillery Company to use their ground for the ascent of 'the largest balloon ever made in this country', on the plea that the use of it for 'other than a Military purpose, tended to divert individuals from their useful labour [and] might interrupt the public peace'. In April it was said that Moret would shortly make an ascent, and at the end of the month a further notice announced that during an experimental inflation it required thirty men to hold the machine down. Of the promoter of the project (who it is said was of Swiss origin), nothing appears to be known beyond his having toyed with small balloons in Paris, and he can be credited with little more than foresight in being amongst the first to realize the possibilities of exploiting the attractions of a balloon ascent as a commercial speculation.[3]

Chevalier de Moret's Project, 1784.

[1] See note, p. 108, *ante*.

[2] See cuttings in Lysons's *Collectanea*, vol. iii, in the British Museum (press-mark, 1889. e. 5). In the Banks Collection (1890. e. 15) there is an engraving of the 'New Aerostatique Machine' in the form of a 'Chinese Temple' to ascend on Aug. 10, 1784, which shows two braziers for heating the air within the machine. The dimensions are given as 65 feet high and 120 feet circumference. An earlier plate of the same (with the engraved date 'May' altered in MS. to 'Augt.', 1784) is reproduced by Lockwood Marsh, no. 37.

[3] Tissandier, vol. i, p. 106. Cf. Lunardi in his *First Aerial Voyage*, 1784 (pp. 14–15), who refers to him as 'a Frenchman whose name is Moret, and who may possibly have assisted at some trials in Paris to launch Balloons in the manner of Montgolfier'.

In July he issued announcements to the effect that an aerostatic exhibition would be held at the Lyceum in the Strand. 'M. Chevalier has the honour'—so runs the wording of one of his specious if attractive advertisements—'of announcing to the Nobility of England that the Grand Aerostatic Globe of the immortal M. Montgolfier is just arrived in this Capital from Paris in its progress to the University of Oxford', though the place of exhibition was apparently altered to Pimlico. The inventor, it continues, having ordained that his Air Balloon should be exhibited to the English public free of expense, the Chevalier permits the domestic 'who has the honour of superintending it, to receive but One Shilling from each person', and for this modest honorarium the spectator is assured a sight of the balloon, 40 feet in circumference, overlaid with decorations representing the constellations—a wondrous spectacle indeed, if (as was claimed) it suggested 'the appearance of a huge world floating in the incomprehensible infinity of eternal space!' A gallery for the use of visitors was attached beneath the balloon, which was doubtless inflated with atmospheric air and suspended from above—an easy method of investing the 'machine' with an appearance of reality.

Moret's Attempted Ascent, Aug. 10, 1784.

Subsequent announcements that the price of admission had been reduced to sixpence, and that a 'beautiful print of an Air Balloon and of M. Montgolfier filling it will be given gratis', further suggest the pecuniary aims of the scheme. A final notice informed the public that 'Chevalier de Moret will ascend in the Grand and Magnificent Air Balloon, the Chinese Temple, on August 4', and a week later the attempt was made at Five Fields Row, Chelsea. The result was entirely disastrous, and must have acted for months to come as a warning to would-be adventurers in the air. A vast concourse of people, eager witnesses of the first attempted flight into the air in England, assembled in the vicinity of the Star and Garter, Chelsea, thronging the adjoining fields, the roads, the trees, and the tops of the houses, a small number paying for admission to the place of ascent.[1] The balloon was of the 'Montgolfière' or 'hot-air' type, and was described—despite the fact that it was constructed of very coarse and porous cotton, with a light

[1] Tickets varied from half a crown to a guinea, and were to be sold through booksellers, in whose hands the money was to remain until after the ascent. Dr. Johnson subsequently pointed out that it was 'not very necessary' to pay for admission, because in less than a minute those a mile away would see all there was to see (*Life*, by Birkbeck Hill, vol. iv, 1887, p. 359).

covering of paper—as having presented a beautiful appearance. For three hours the expectant but patient multitude watched the novel process of inflation by means of burning straw, but the 'machine' gave no indication whatsoever of any power to ascend, and evidently doubts arose as to the genuineness of the attempt. Whether the balloon at length caught fire, or whether its final destruction was due to the violence of disappointed and enraged spectators is not clear, but there is no doubt the mob burst through the fences that enclosed the gardens, surrounded the object of their resentment, and tore the burnt and tattered fragments to pieces. The so-called 'Chevalier', thanks to the humanity of a few witnesses of the disaster, made his escape under cover of the smoke—or, it was said, 'in all probability, he would have shared the fate of his unfortunate machine'. A few days later Moret issued an apology through the press, in which he was careful to explain that no money was taken by him; [1] that a successful experiment on August 2nd had demonstrated the machine was capable of lifting four men, and that (added to wet weather making the envelope heavy) the real cause of the disaster was some difficulty in disengaging one of the cords which had supported the balloon during inflation. He is not known, and is hardly likely, to have made any further experiment—indeed his disastrous attempt can have had no other result than that of fostering incredulity, and tending to associate all such endeavours in the public mind with fraudulent intentions.[2]

Keegan's English Balloon, Aug. 1784.

The origin of the other projected ascent, which was also designed to take place prior to Lunardi's first venture, but which ended as disastrously as the fiasco of Moret, is even more obscure. Possibly the most authentic account of the genesis of it is that given by Faujas de Saint-Fond, who—himself interested in the new science of aerostation—had frequent opportunities during his stay in London early in August 1784, of hearing about the project from the prime mover of it, Dr. John Sheldon. Sheldon, a noted anatomist of his day, took a keen interest in aerostation, and by reason of his ascent with Blanchard from Little Chelsea on October 12,

Dr. Sheldon's Interest in it.

[1] On Aug. 17 a caricature on the event was published bearing the legend, 'English Credulity, or the Chevalier Morret taking a French Leave', in which this adventurer, holding in his hand a bag of guineas, is shown ascending beneath a balloon. A caricature of similar intent is reproduced in Grand-Carteret, p. 104.

[2] See news-cuttings in the Patent Office and Cuthbert Collections. Also Lysons's *Collectanea*, vol. iii, in the British Museum.

1784, is usually said—though, as will be seen, on doubtful grounds—to have been the first Englishman to go up in a balloon.[1] Faujas wrote with warm appreciation of Sheldon's personal qualities, of his vivacity, and his extraordinary passion for study.

'The discovery of air balloons', he says in an account of several visits to examine Sheldon's anatomical collection, 'excited his [Sheldon's] enthusiasm. He no sooner learned what had been done in Paris on the subject, than he suspended a part of his anatomical labours, to make calculations respecting the weight of the atmosphere. He afterwards directed his enquiries to the discovery of the most proper substance for making the covering of balloons, to improving the varnish, and to the inventing of the most convenient apparatus for simplifying and perfecting these machines. He visited all the shops and manufactories of London, to gain information on these subjects. He told me that he intended to go to France soon, in order to pay his respects to Montgolfier, Pilâtre and Charles; and to see the improvements they had made in the art of aerostation. . . . But his active mind did not permit him to wait so long before he carried his favourite design into execution, and, in concert with Major Gardner, he constructed in Lord Foley's garden an aerostatic globe fifty-six feet in diameter made of varnished linen. It was filled with air, rarified by fire. He informed me that he meant this merely as a trial, upon a small scale, calculated to enable him to study this machine; but he was of opinion that experiments would be more satisfactory, if they were made, as he hoped they one day would be, upon very large aerostatic globes.'[2]

The date of these visits to Sheldon is not recorded by Faujas, but they must have been some days before August 15, 1784, and also presumably before Sheldon had come to know Blanchard, the celebrated aeronaut, who certainly took some part in the project.[3]

Apparently the so-called 'English Balloon'—again of the 'Montgolfière' type, though in shape 'a perfect cylinder'— was constructed by Allen Keegan, of whom little is known beyond the fact that he was a tradesman in the Strand (dealing in umbrellas and waterproof articles) and had undertaken the construction of

[1] *D. N. B.*, vol. lii, p. 27.

[2] Faujas de Saint-Fond (B.), *Journey through England and Scotland*, 1907, vol. i, pp. 40–1. Col. Gardner was aide-de-camp to Sir William Howe in America.

[3] See *post*, Ch. VII, p. 162. The balloon was usually known as 'Keegan's Balloon', though before the failure it was mainly connected with the names of Sheldon and Gardner. As was ironically pointed out by a newspaper writer in the following October, it having 'failed, we are given to understand it was in fact poor K . . . n's balloon'.

FIG. 17. CARICATURE OF KEEGAN'S 'ENGLISH BALLOON', PORTLAND PLACE, SEPT. 1784.

e small balloon released at Sandwich in the preceding February.[1] ade of nearly 3,500 yards of coarse linen cloth, painted over with)iled oil as a varnish, the dimensions of this strange-looking oblong ılloon were 80 feet broad by 84 feet high, and it was said to be e largest balloon at that time made in this country. Beneath ı aperture of 50 feet in circumference there was fitted a more aborate apparatus than anything hitherto devised for inflating hot-air balloon, consisting of an iron net and pan (7 feet in ameter) to hold the fire, over which was fixed a hinged cover to t as an extinguisher in case of need. Below this again was gallery of network, upwards of 70 feet in circumference, kept ›en by strips of deal and bamboo cane, designed to accommodate ur aeronauts and a quantity of fuel, the latter consisting of ıall bundles of straw—chemically treated so as to give 'a very ›werful smoke with a smothered flame'—and a quantity of ctified spirits of wine contained in sheep's bladders. 'As the eat danger will be that of taking fire'—so runs a contemporary scription, in words which the disastrous outcome proved to unduly complacent—four hand-engines, together with sufficient ater, formed part of the equipment. The total weight was comıted at two tons, with a 'lift', when inflated, of 16,000 lb.

Owing to Sheldon's scientific attainments it was hoped that e voyage would be one of some profit to science, among other periments to be carried out being the effect of the atmosphere ı sound (to be tested by means of the explosion of a gun at fferent heights), and upon motion, for which purpose a number birds were to be taken up. It was originally intended to ascend om the Rolls' garden in Chancery Lane,[2] or from Lord Talbot's rden in Lincoln's Inn Fields, but these sites being found inconnient the Duchess of Devonshire induced Lord Foley to grant e use of his grounds in Portland Place. The event was arranged take place early in August, but for one reason or another it as delayed. On the 16th of the month large crowds assembled the neighbourhood on a report that the balloon really was to launched, but nothing more than a preliminary inflation was tempted, the machine (with two men in the gallery) rising no gher than the length of the ropes by which it was held. Owing

[1] The Sandwich experiment (see p. 103, *ante*) is described by Cavallo (pp. 123–4), but egan's name is not mentioned. There is no mention of Keegan in *Astra Castra.*
[2] Hist. MSS. Commission Reports . MSS. of Lord Kenyon, 1894, p. 517.

to some damage on this occasion the free ascent was further postponed, and on September 25th Keegan announced to the ticket-holders another short delay on account of bad weather. Four days later the attempt was renewed, and though what happened is not fully recorded, it is known from a note in Windham's *Diary* that the balloon caught fire and was utterly destroyed on September 29th.[1] The affair thereupon became the subject of satire and recrimination—Sheldon appears to have laid the blame on Gardner, while an action at law was commenced against them both by Keegan for the burning of his balloon. Three interesting caricatures of the ascent (as described in a later chapter) engraved in mezzotint without any imprint, were published after the event.[2]

Its Destruction, Sept. 29, 1784.

Ten days earlier a more hopeful chapter in the history of ballooning had opened with Lunardi's successful ascent from Moorfields.

[1] *Diary of Wm. Windham*, 1866, p. 24. The disaster next day was briefly announced in one newspaper as follows : 'The folly balloon . . . gave up the ghost in a blaze between 4 and 5.' Dr. Johnson wrote on hearing of the disaster that he did not much lament it—'to make new balloons, is to repeat the jest again' (Birkbeck Hill's edition of *Boswell*, vol. iv, p. 358).

[2] See Ch. IX, p. 215.

CHAPTER V

VINCENT LUNARDI: THE FIRST AERIAL VOYAGER IN ENGLAND

Vincent Lunardi (1759–1806).

COMPARATIVELY little is known of the life of Vincenzo Lunardi beyond his aeronautical exploits.[1] He is said to have been born at Lucca on January 11, 1759, and in early life to have been sent to the East Indies. On his return he was chosen to accompany Prince Caraminico to London, on the appointment of the latter as Neapolitan Ambassador to the Court of St. James's, and he subsequently became First Secretary to the Embassy. Handsome in appearance, as the attractive portraits by Cosway and others sufficiently testify, he was gifted with a vivacity and charm of manner which, together with his youthfulness—he was at this time only twenty-two—went far to call forth enthusiasm and support for his ballooning exploits. To his southern temperament may doubtless be ascribed those sensitive, emotional qualities, that impulsiveness—often amounting to rashness—and the alternating moods of elation and depression, which were such marked traits in his character. Against his personal vanity, the common weakness of a desire for worldly fame, and an unpleasing vein of sentimentality, must be set the virtues of courage and determination, as well as powers of shrewd observation, which, combined with a keen sense of honour and a generous disposition, evoke no small measure of admiration. Doubtless inspired by the aeronautical experiments made in London by his fellow-countryman and rival, Count Zambeccari, Lunardi was fired with the ambition of making the first balloon ascent in England.

Anxious to make sure, before actually 'engaging in so expensive an undertaking', of some place from which to ascend, he wrote early in July 1784 to Sir George Howard, the Governor of Chelsea Hospital, asking permission to use the hospital grounds as 'a

[1] By the courtesy of His Excellency the Marquis Imperiale, when Italian Ambassador in London, a search was made in the Royal Archives of the State of Naples for records concerning Lunardi (who, during his residence in England, invariably used the form Vincent for his christian name) with little result save for the discovery of certain printed letters. See *D. N. B.*, vol. xxxiv, p. 278, and Boffito, ch. xv. The latter gives references to other sources of information.

picturesque and propitious spot' for the event. This request, with the approbation of George III, was promptly granted, Lunardi on his part having undertaken to divide amongst the pensioners at the institution any profits accruing from his project. Not being possessed of sufficient funds to defray even the initial expenses, his next step necessitated an arrangement for some public subscription, and the exhibition of his balloon when constructed. On the completion of the gallery (or car), oars, and wings, Lunardi issued an advertisement to solicit 'the assistance of the liberal promoters of ingenuity', acquainting them of his proposal, and announcing that the balloon was then under construction at the Lyceum in the Strand. Though this appeal apparently brought him into touch with men of rank and influence —Sir Joseph Banks was amongst the first to subscribe—Lunardi was disappointed at the slow response and the comparative lack of interest excited by his scheme. It progressed, however, so far that early in August announcements appeared in the press stating that the 'stupendous Aerostatic Machine', being nearly completed, was on exhibition in a 'floating state' at the Lyceum, prior to an early ascent from the Chelsea Hospital grounds.[1]

His First Balloon, 1784.

The balloon was made of oiled silk in alternate strips of blue and red, being spherical in shape, 33 feet in diameter, 103 feet in circumference, and when inflated with inflammable air having a capacity of 18,200 cubic feet.[2] It was two-thirds covered with a strong net, from which hung forty-five cords for the suspension of the 'gallery'; but it is noticeable that Lunardi did not fit any valve, relying on the open neck of the envelope for any necessary escape of gas—an unscientific method, the danger of which he evidently did not realize at this time. Indeed, his ideas were obviously those of an enthusiastic amateur, and he lacked the scientific interests and mechanical experience of the Montgolfiers or the higher scientific attainments of Charles. This is seen in the description of the wings and oars given by Lunardi himself in one of his letters, wherein he explained that 'the use of the former is to excite air when the globe is becalmed, and thereby to move it horizontally; they have the form of large rackets and are covered with a loose flounces [*sic*] of oiled silk'. 'The oars', he continues,

[1] See Patent Office Collection, vol. iii, fo. 2, for a ticket for the ascent at Chelsea, on which Lunardi gave an undertaking to return the money in event of failure. (Cf. Fig. 19.)

[2] Cf. *A Particular Description of Mr. Lunardi's Aerial Voyage . . . To accompany the Prints of his celebrated Balloon*, two leaves, 4to [1784].

1785

GRAND ENGLISH BALLOON.

To the Nobility, Gentry, and Public in general.

A LARGE AND CURIOUS

BALLOON

IS NOW CONSTRUCTING AT THE

LYCEUM near EXETER-CHANGE, STRAND,

ON A PLAN ENTIRELY NOVEL,

And which has originated in this METROPOLIS,

FROM THE INGENUITY OF A

GENTLEMAN,

WHO IS TO ASCEND WITH IT.

The Conſtruction is now begun at the above Place, and when the GLOBE (the Materials of which are oiled Silk of different Colours) is completed, it will be filled with Inflammable Air, and launched from

Chelſea Hoſpital Gardens,

Having obtained Permiſſion for that Purpoſe.

The Object of the Gentleman's Ærial Tour is to make ſome intereſting Experiments, by which it is preſumed this Nation will diſcover its real Utility.

THE GALLERY, OARS AND WINGS ARE NOW FINISHED.

SUBSCRIPTIONS are received at the OFFICE adjoining to the LYCEUM, where TICKETS may be had.

ONE GUINEA Ticket will admit a Perſon Four different Times, to ſee the Conſtruction, and likewiſe into the Garden, intitled to have a Chair near the GLOBE to ſee it launched off.

A HALF GUINEA Ticket will admit a Perſon to ſee the Conſtruction Twice, and likewiſe into the Garden, intitled to have a proper Bench to ſit down on, next to the above Subſcribers.

FIVE SHILLING Tickets will admit a Perſon Once to ſee the Conſtruction, and likewiſe into the Garden to have a proper Bench to ſit down on

The above ROOM is now open from TEN o'Clock till EIGHT o'Clock, for the Admiſſion of SUBSCRIBERS, where the CONSTRUCTION, GALLERY, OARS, and WINGS, together with other BALLOONS may be ſeen.

Admittance for Non-Subſcribers Two Shilling and Six-pence each.

Printed by J P COGHLAN, in Duke-Street near Groſvenor-Square.

Fig. 18.

'which differ from the wings only in size, will be worked with a vertical Motion, and are intended to effect a depression of the machine; by which I hope to be enabled either to check its ascension, or to descend without the necessity of letting out the inflammable air.'[1]

His Ascent from Chelsea forbidden.

But before being able to put to the test the complete confidence he had in his balloon, Lunardi was destined to undergo for the first time in his aeronautical career, the experience of those rapid changes from elation to despair, which he not unjustly compared with the variable climate of this 'extraordinary island'. On August 14th—three days after Moret's fiasco—Lunardi received a letter written on behalf of Sir George Howard, withdrawing the permission granted, on the ground that the governor was determined not to run the risk of any similar riot to that which had occurred in neighbouring grounds at Chelsea.[2] This sudden refusal plunged Lunardi into despair, though, in view of the widespread public suspicion that all such projects were merely the fraudulent schemes of impostors and cheats, the decision was warranted. Indeed, while recognizing the interest shown by some scientists in aerostation, Lunardi realized that the sceptical attitude of the public—increased by the prevailing prejudice against anything originating from France—was a factor to be reckoned with. Within a month, however, he was able to record that 'what philosophers dare not attempt, the ladies easily accomplished. They can smile into acquiescence that uncouth monster public prejudice, and they regulate the opinions and manners of a nation at pleasure'.

Exactly how they assisted him in this predicament is not known, but thanks to the casting vote recorded on two occasions by Sir Watkin Lewis, as Chairman of the Court of Assistants of the Honourable Artillery Company, Lunardi obtained permission to ascend from the Artillery Ground at Moorfields, on the condition that he paid a sum of one hundred guineas to the fund then being raised for the support of the children of Sir Barnard Turner, who had been recently killed in an accident. On September 11th

[1] See *First Aërial Voyage*, 1784, p. 11. The intended position of the wings and oars are shown in a plate of 'Mr. Lunardi's celebrated Air-Balloon', prepared for the ascent as arranged at Chelsea, and published in August 1784. (Fig. 20). The ground view and some details were subsequently altered and the print sold as depicting the ascent on Sept. 15. The wings were discarded before the ascent and are not shown in the plate of the balloon which accompanied Lunardi's own *Account*.

[2] See Ch. IV, p. 113.

Fig. 19 Admission Ticket for Lunardi's Proposed Ascent from Chelsea, Aug 1784

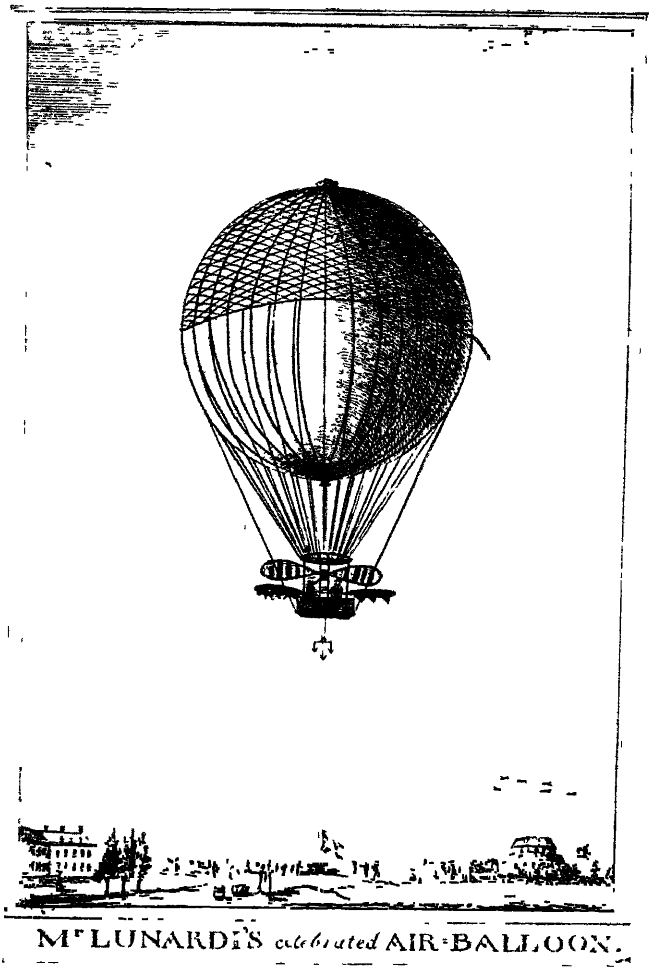


Fig 20. LUNARDI'S FIRST BALLOON, 1784
From the First State of an Engraving prepared for Chelsea, and subsequently altered to represent the Artillery Ground.

announcements appeared fixing the date for 'the 15th inst. between 12 and 1 o'clock, if weather permits', the prices for admission ranging from five shillings to one guinea—the latter 'for a chair near the Globe'—those tickets which had been acquired for the proposed ascent at Chelsea being made available. Other difficulties—which Lunardi recounts with vigour and feeling—arose in connexion with the proprietor of the Lyceum where the balloon was exhibited,[1] but his new friends came to his assistance, and eventually, though not until the day actually preceding the advertised date, the balloon was forcibly removed and conveyed under guard to the Artillery Ground. All that night Lunardi was superintending the inflation with hydrogen by means of Dr. Fordyce's apparatus—said to be an improvement on the French method of preventing the admission of any atmospheric air—which, though slow in action, gave promise of success.[2]

His First Ascent, Sept. 15, 1784.

The dawn of the auspicious day must have been greeted by Lunardi with mingled feelings of hope, doubt, and fear—hope inspired by the ambition to succeed, doubt arising from the uncertainty of this new experience, and fear prompted by the recollection of Moret's fate and the dread of mob violence certain to result in the event of a second failure. The story of his success is well known and need not be repeated at length—Lunardi himself published before the end of the month *An Account of the First Aerial Voyage in England,* wherein he records the whole affair from start to finish, in a style which, if possessing no literary merit, is vivacious and picturesque, faithfully reflects the writer's characteristics, and reveals a fluent if imperfect command of English.[3]

According to an eyewitness the weather was perfect, and under an 'Italian sky', a vast concourse of people—variously estimated, according to the temperament of the observer, at thirty or three hundred thousand—assembled to witness so novel and extraordinary a spectacle. The Prince of Wales honoured Lunardi by his attendance and expressed solicitations for his safety; Pitt, Fox, Burke, Lord North, and numerous other distinguished personages of the day, were among the spectators, while the accom-

[1] Upwards of 20,000 persons paid for admission, but apparently Lunardi did not greatly profit. (See *First Aërial Voyage,* 1784, p. 23.)

[2] Cf. *ante,* Ch. III, p. 98.

[3] The *Account* was published with a portrait by Bartolozzi after Cosway at five shillings, or without at half-crown. Three editions were called for before the end of the year. It was reprinted in *Astra Castra,* 1865.

plished and beautiful Duchess of Devonshire, with other ladies of rank and fashion, viewed the event from an adjacent balcony.[1] The apparatus for making the hydrogen was set up in the middle of the ground, but though the inflation had been in progress all the

AN

ACCOUNT

OF THE

First Aërial Voyage in *England*,

In a SERIES of LETTERS
to his GUARDIAN,

Chevalier Gherardo Compagni,

Written under the Impressions of the various Events
that affected the Undertaking,

By VINCENT LUNARDI, Esq.
Secretary to the Neapolitan Ambassador.

A non esse, nec fuisse, non datur argumentum ad non posse.

LONDON.

Printed for the AUTHOR: and sold at the PANTHEON; also by the Publisher, J. BELL, at the BRITISH LIBRARY, Strand, and at Mr. MOLINI'S, Woodstock-Street.

M,DCC,LXXXIV.

Entered at Stationers Hall.

Fig. 21.

previous night, it was found by about midday—much to Lunardi's distress—that the balloon had considerably less lift than he had

[1] A drawing of the scene (in the Patent Office Collection, vol. 2, fo. 2) was made on the spot by Paul Sandby; a large aquatint was engraved by Jukes after Brewer (Fig. 22), and numerous other prints were published at the time. See Cuthbert and Banks Collections. The *D. N. B.* reference (vol. xxxiv, p. 278) to the plate in the *European Magazine* is quite inadequate—the latter was only one of many small (and inaccurate) prints.

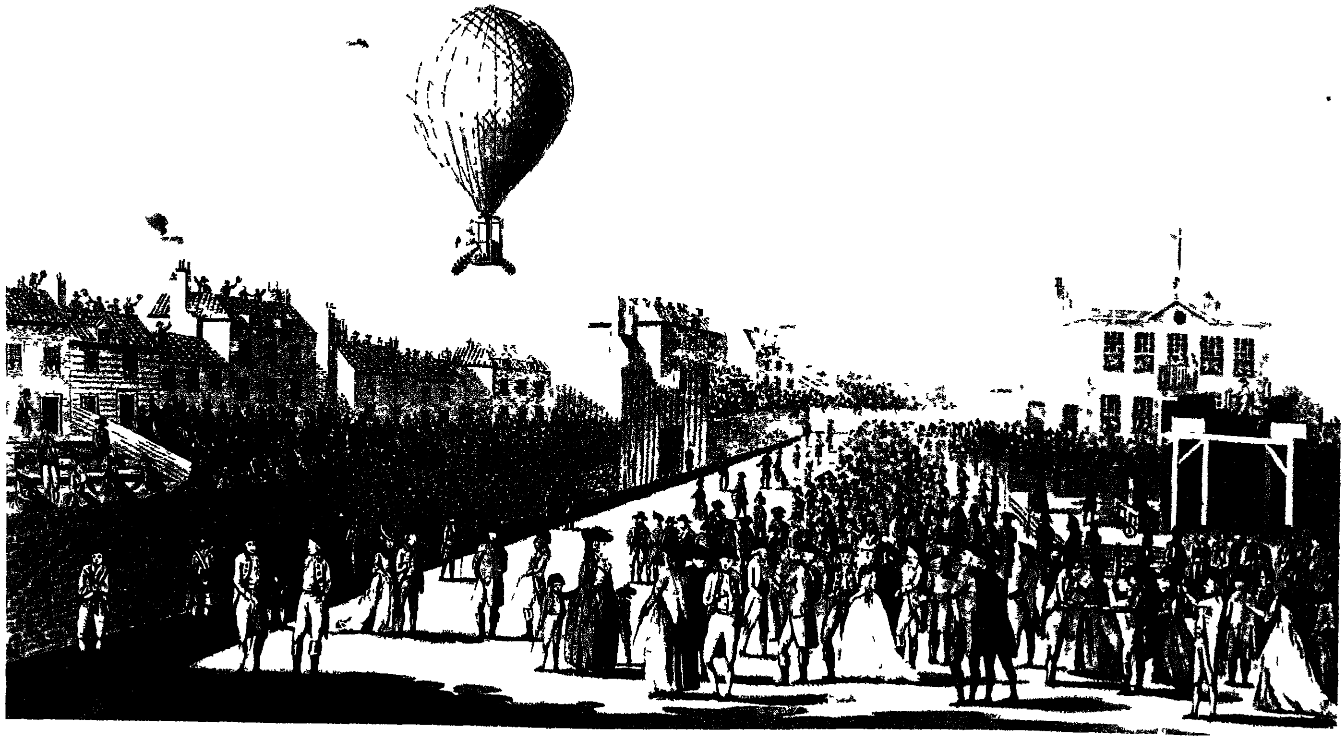


Fig. 22 THE FIRST BALLOON ASCENT IN ENGLAND.
Lunardi at the Artillery Ground, Moorfields, Sept 15, 1784.

estimated. He was consequently obliged greatly to disappoint his friend and patron, George Biggin, whom he had promised to take up.

It was shortly before 1 o'clock that Lunardi (who had previously made his will) shook hands with the Prince, climbed into the car with his cat and dog, and the balloon was released. Rising very slowly above the spectators, whose attitude of incredulity was instantaneously transformed into wonder and delight, the aeronaut was greeted with tumultuous shouts of acclamation, in response to which he threw down his flag. At first the balloon was carried in a westerly direction, but it soon changed to north, and after rising to an altitude estimated by Lunardi at four miles, he descended near the ground at North Mimms, gave his cat in charge of a woman, and again rose into the air. He was followed on horseback by Dr. John Sheldon (who thus showed his keen interest in aerostation), and finally landed in a field in the parish of Standon, near Ware, in Hertfordshire, not without some difficulty and danger, owing partly to the unwillingness of the countryfolk to help, and partly to the balloon being 'light'. The distance travelled was approximately twenty-four miles, Lunardi having been in the air for about two hours and a quarter.[1]

In popular estimation Lunardi's success was complete—eulogistic accounts appeared in the newspapers, effusions in verse were addressed to the bold 'flyer', the event was a universal topic of conversation, and Lunardi bonnets and even Lunardi garters became the fashion among ladies.[2] For several weeks the balloon was exhibited at the Pantheon in Oxford Street, together with the dog and cat—the two latter on the ground that every circumstance, however trifling, 'is interesting when connected with [this] great and important adventure'—while a testimonial subscription was opened at various clubs and coffee-houses, and a silver medal struck to commemorate the event.[3] The young aeronaut was

[1] Lunardi's own account of the ascent, as presented to the Court of the H.A C. on Sept. 17, is printed in Raikes's *History of the H.A.C*, 1879, vol. ii, p. 108

[2] On Sept. 18 Johnson wrote, 'I had this day in three letters three histories of the Flying Man in the great Balloon' (Johnson's *Letters*, ed. Birkbeck Hill, 1892, vol. ii, p. 419).

[3] A water-colour drawing of the interior of the Pantheon and the balloon was painted by F. G. Byron (sold at Sotheby's in the J. E Gardner Collection of Prints, &c., lot 601, Mar. 2, 1923). It was engraved in aquatint by V. Green (Lockwood Marsh, no. 42), some copies being printed in colours. The medal bore a portrait of the aeronaut, with the motto, 'Et se protinies [*sic*] Aetherea Tollit in Astra Via', and on reverse the balloon, with oars, anchor, &c. (Fig. 30).

presented at Court, and recorded the personal attention paid him by the Prince of Wales with such obvious touches of vanity as to lead Cavallo (who in his *History of Aerostation* described the ascent with scarcely veiled disdain) frankly to suggest that Lunardi was poisoned by the general applause. But if so his success also encouraged him to make further endeavours, and before the end of the year announcements appeared as to the completion of a new and improved balloon, larger than any hydrogen balloon hitherto constructed, and painted in the colours of the national flag of Great Britain—an idea suggested to Lunardi by 'his regard and attachment to every thing that is English '.[1]

The Second Ascent, May 13, 1785.

The new balloon remained on exhibition during the winter months, Lunardi frequently attending to give explanations in person, and early in the spring it was announced that a second ascent would be made from the Artillery Ground. The event was eventually fixed for May 13th, apparently under much the same conditions as before, though with a result that was far from a repetition of the former success. Lunardi had announced that he would be accompanied by his 'ingenious friend', George Biggin, with the addition of a lady, but again he misjudged the 'lift' of his balloon and had to ascend by himself. After rising to a considerable height the balloon was driven over Gray's Inn and began to descend rapidly—possibly on account of the gas escaping from a rent in the neck of the envelope, but more probably owing to insufficient inflation, though in a subsequent announcement Lunardi himself refers to a mysterious failure.[2] In less than half an hour he descended near the Adam and Eve Gardens in Tottenham Court Road, and was immediately surrounded by a great mob, at whose hands he received an amount of attention which was not wholly complimentary, and from which he escaped with some difficulty. It was doubtless in view of this failure that he was obliged to seek a new ground for his next attempt, but having 'contrived a new apparatus for filling the Balloon', and having overcome some difficulty in obtaining sufficient iron filings—which necessitated further delay and which he attributed to emissaries employed by

[1] This balloon had 5,000 cubit feet greater capacity than the original one. The ornamented gallery, though weighing only 76 lb, seated ten people and was 'formed for sea or land' (Fig. 27). It is said that Lunardi received over £2,000 as his share of the profits arising from the exhibition at the Pantheon.

[2] Insufficient inflation is the explanation given by Mrs. Sage who was to have ascended. See her *Letter addressed to a Female Friend* [1785], p. 6.

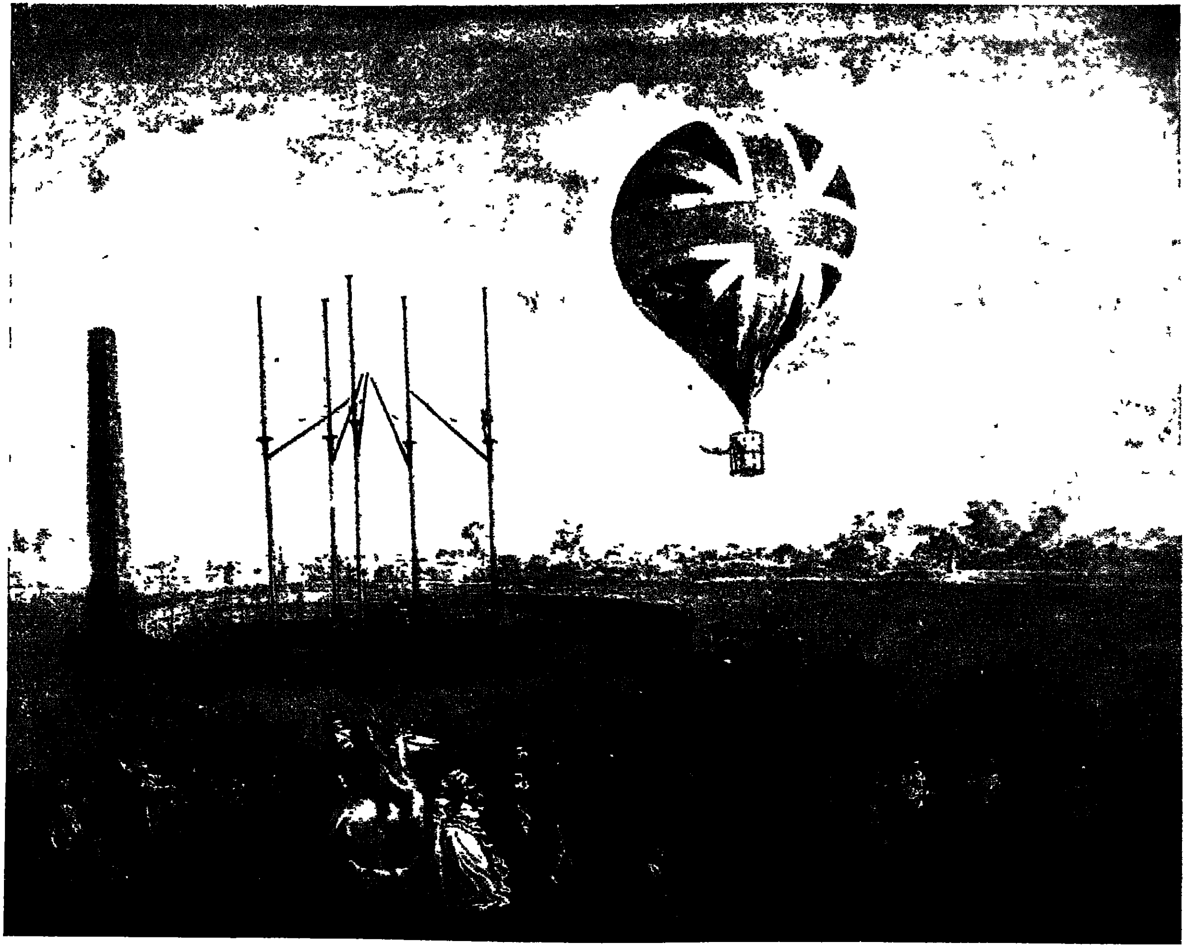


Fig 23 LUNARDI'S SECOND BALLOON AT ST GEORGE'S FIELDS

his competitors—he announced a gratuitous ascent from St. George's Fields, Newington Butts.[1]

Ascent of Biggin and Mrs Sage, June 29, 1785.

Despite Lunardi's failure on two former occasions to carry out his intention of allowing Biggin to accompany him, he once more gave out that he would ascend with 'an English Lady and Gentleman'.[2] The inflation was commenced at 9 o'clock on the morning of June 29th, the balloon being raised above a stage so that all should view the operation, and after some delay, owing to the difficulty of obtaining sufficient water, was completed by 1 o'clock, at which time more than a hundred thousand persons had assembled in the vicinity. Lunardi, Biggin, Colonel Hastings, Mrs. Sage, and another lady, having got into the gallery, the balloon failed to rise, and eventually all but Biggin and Mrs. Sage had to retire, Lunardi giving place to the former in order not to disappoint him a third time, and to the latter, doubtless as a chivalrous and gracious return for the favours he had received at the hands of the ladies (Fig. 26). The immense crowd—possibly augmented to some extent by a knowledge of the terrible disaster which had befallen Pilâtre de Rozier only a fortnight before—again enjoyed the sight of a great spectacular success, though owing to the hurry of departure some of the scientific instruments and oars which Biggin had intended to take with him were left behind. Mrs. Sage, in her *Letter describing the General Appearance and Effects of her Expedition with Lunardi's Balloon*—on the title-page of which she styled herself quite accurately, and with pardonable ostentation, as 'The First English Female Aerial Traveller'—described the voyage with both admirable spirit and a pleasing, unaffected talent for description.[3] Her composure in the enjoyment of an excursion with which, as her *Letter* records, she was 'infinitely better pleased . . . than I ever was at any former event of my life', is proved by careful notes made during the voyage in a book carried for the purpose. Passing

[1] St. George's Fields was at this time managed by a retired seaman, Stuart Amos Arnold, as a circus and garden of amusement (see *post*, Ch. VIII, p. 189). A pencil drawing in the Cuthbert Collection of Lunardi's 'Balloon in which Mrs. Sage & Mr. Biggin ascended, as it appeared when filled, May 1785, from Newington Causeway', signed 'W. Capon', is endorsed, 'Mrs. Sage did not go up', which suggests another attempted ascent. Cf. Fig. 23, the original of which is undated.

[2] George Biggin, who had supported Lunardi from the outset, is said to have distinguished himself at Eton. Having inherited substantial means, he subsequently achieved distinction as a patron of the arts and 'one of the best gentleman chemists in this country', while his name still survives in his invention, the 'coffee biggin'. He died suddenly in April 1803, at the early age of forty-three

[3] *A Letter addressed to a Female Friend* [written from 10 Charles Street, Covent Garden], by Mrs. Sage [1785] (Fig 24)

over Westminster, St. James's, and Piccadilly, the balloon was carried over Ranelagh—which 'appeared to resemble a tea caddy'—and crossing and recrossing the Thames, descended near Harrow, after a voyage of about an hour's duration. Mrs. Sage having got out, Biggin—who appears to have piloted the balloon with

A

L E T T E R,

ADDRESSED TO

A FEMALE FRIEND.

BY

MRS. SAGE,

The first English FEMALE AERIAL TRAVELLER;

DESCRIBING

THE GENERAL APPEARANCE AND EFFECTS

OF HER EXPEDITION

WITH

MR. LUNARDI'S BALLOON;

Which ascended from St. George's Fields on Wednesday, 29th June, 1785,

ACCOMPANIED BY

GEORGE BIGGIN, ESQ.

LONDON

PRINTED FOR THE WRITER,

AND SOLD BY

J BELL, BRITISH LIBRARY, STRAND.

(PRICE ONE SHILLING)

Entered at Stationers-Hall, according to Act of Parliament.

Fig. 24.

remarkable judgment, seeing that he had had no previous experience of ballooning—proposed to ascend again, but his intention was frustrated by an irate farmer in whose field the balloon descended, and who assumed an aggressive attitude on account of alleged damage to his crops.[1] The balloon having been dispatched to

[1] According to Mrs. Sage it was entirely due to the boys of Harrow School—who appeared as charming in her eyes as doubtless she was attractive in theirs—that the

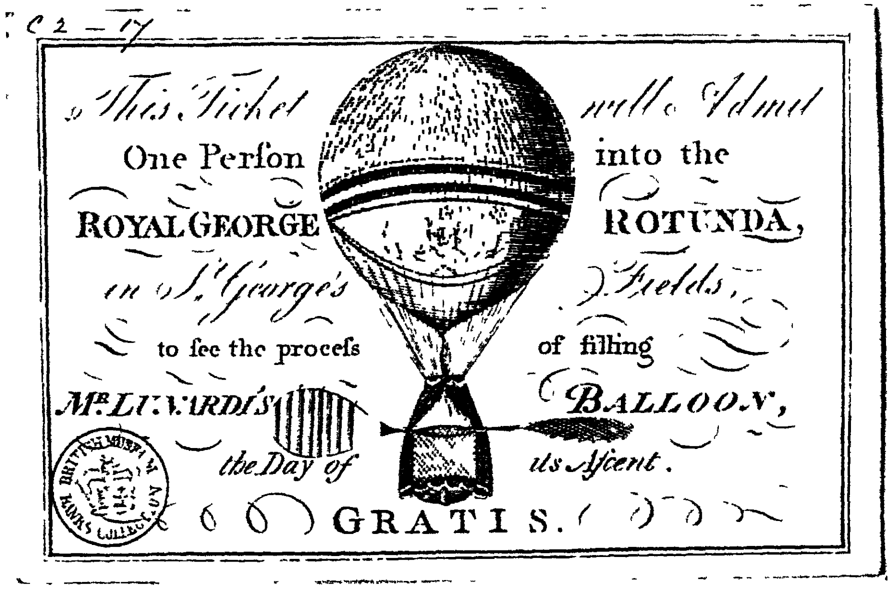


FIG 25 Admission Ticket for Lunardi's Second Balloon, St George's Fields, Southwark June 1785

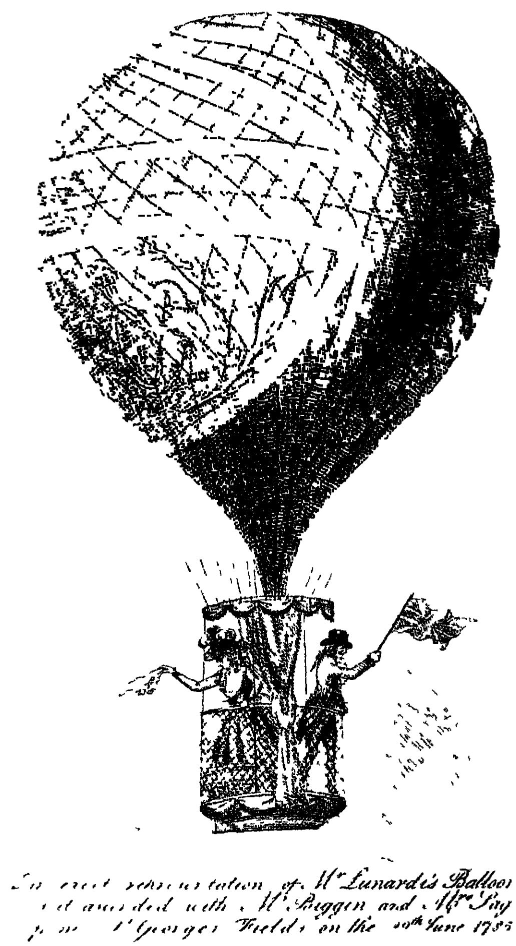


FIG. 26 An Exact Representation of Lunardi's Balloon, as it ascended with Biggin and Mrs Sage, June 29, 1785.

London, Biggin, and Mrs. Sage, after being entertained at Harrow, drove back to London late that night.

His First Liverpool Ascent, July 20, 1785.

Meanwhile Lunardi's ambition had begun to travel farther afield, and he appears to have made provisional arrangements for ascents at Liverpool and Lancaster, during visits he made to those cities in June the same year. Eventually he travelled north early in July, spending a day at Oxford, where he enjoyed a 'flattering Reception', and—a fact of greater interest—where he met James Sadler, the first English aeronaut, to whose generosity and good nature it is pleasing to find Lunardi admits his indebtedness. On July 12th he arrived at Liverpool, and the next day procured the necessary materials and apparatus for filling the balloon, while he obtained permission to make his ascent from the grounds within the fort, pleasantly situated at that time below the town and near to the entrance of the Mersey.[1] As usual the balloon, inflated with atmospheric air, was exhibited to the public prior to the ascent, an exhibition which led to a curious incident, the top of the envelope being 'entirely blown out' owing to too much air being pumped in. Though wind and weather were favourable for the next few days, heavy clouds began to gather early on the morning of the 20th, but despite the thunder and rainstorms which followed before noon, Lunardi, fearful of his honour, expressed his determination to ascend 'though surrounded with danger'—a determination which was 'unalterably settled' when, early in the afternoon, the rain and the wind dropped. At 6 o'clock Lunardi, proudly dressed in the regimentals of the H.A.C.—in which he had been given an honorary rank—entered the car, and the balloon rising but slowly, gave him an opportunity of gazing on the immense and cheering crowds below—clambering up the masts of the shipping, thronging the vantage points in and about Liverpool, or swarming in masses on the yellow sands along the river. That the balloon was not sufficiently inflated is shown by the fact that not only did Lunardi ascend without any ballast, but he had to throw away his uniform, his hat, and, as a last resource, his waistcoat. Nevertheless, he subsequently rose to a height which he

balloon was saved from destruction. Incidentally it may be mentioned (in the discreet seclusion of a note) that Mrs. Sage, who—to judge from Bartolozzi's well-known engraving—was a very handsome woman, herself records that in stepping out of the car at the end of the journey she relieved the balloon of 'two hundred pounds of human weight'. See Lockwood Marsh, no. 54. Also Fig. 28.

1 Announcements appeared in *Gore's General Advertiser* for July 14th advertising the date of the ascent for the 20th inst.

estimated at about 10,000 feet, suffering greatly from the cold, and eventually descended in a cornfield near Symmonds Wood, about twelve miles from Liverpool, shortly after 7 p.m. As there was no wind Lunardi made an easy landing, and he returned to Liverpool, with the balloon carried in triumph, about midnight.

Second Liverpool Ascent, Aug. 9, 1785.

Though not a financial success—the deficiency, however, being compensated by the opening of a public subscription—this first ascent of a balloon at Liverpool created sufficient interest to encourage Lunardi to undertake another, which was arranged for early in August. His printed account of this second ascent affording, as it does, a characteristic and entertaining example of his flamboyant style, may be given in his own words.[1]

'Not a little elated with the Success of my first Voyage, and the Approbation of all Ranks of People, I advertised that I would make a second Ascension, from the same place, on Tuesday the 2nd of August, if the WIND and WEATHER would permit. In the interim I enlarged the BALLOON that I might be enabled to take up a sufficient Quantity of Ballast; instead of the Gallery I prepared a Boat, infinitely lighter, made of twisted Ozier covered with a raw Hide, and, in Consequence of these Improvements, hoped to make many interesting Experiments for my own, as well as the Public Gratification. . . . So sanguine were my Hopes, and so firm was my Assurance of succeeding, that I retired to Rest perfectly composed and easy; no Anxiety prey'd upon my Repose, but SLEEP gently laid his Leaden Mace upon my eye-lids, and every Care was lost in happy peaceful Slumber! What a Transition in my Mind on the ominous Sound that awakened me at three o'clock the next Morning! it was the howling of the Wind in the Chimnies and round the Walls; a sad Mattin-Song for me! The Voice of the Screech-Owl had been a thousand times more pleasant! A strong Gale blew from the S.E. every Blast of which tore a Hope from my trembling Heart, and seemed to rob me of a Glory. There was no probability of a Change taking Place in my Favor that Day, but I determined to go to the Fort and wait the Event, but alas! waiting was to no Purpose; and I experienced the severe Mortification of seeing the innumerable Crouds [*sic*], who had assembled from all parts of the adjacent Country, disappointed.'

Lunardi's own disappointment must have been much more poignant, for this was the first time he had been obliged to postpone an ascent. However, with a characteristic combination of impetuosity and courage, he publicly offered to ascend next day if the Liverpool merchants would arrange to provide vessels to pick him up should he fall into the sea—a request which was persistently

[1] Both the first and second Liverpool voyages are described in letters to George Biggin, subsequently published without imprint or date, and now very rare.

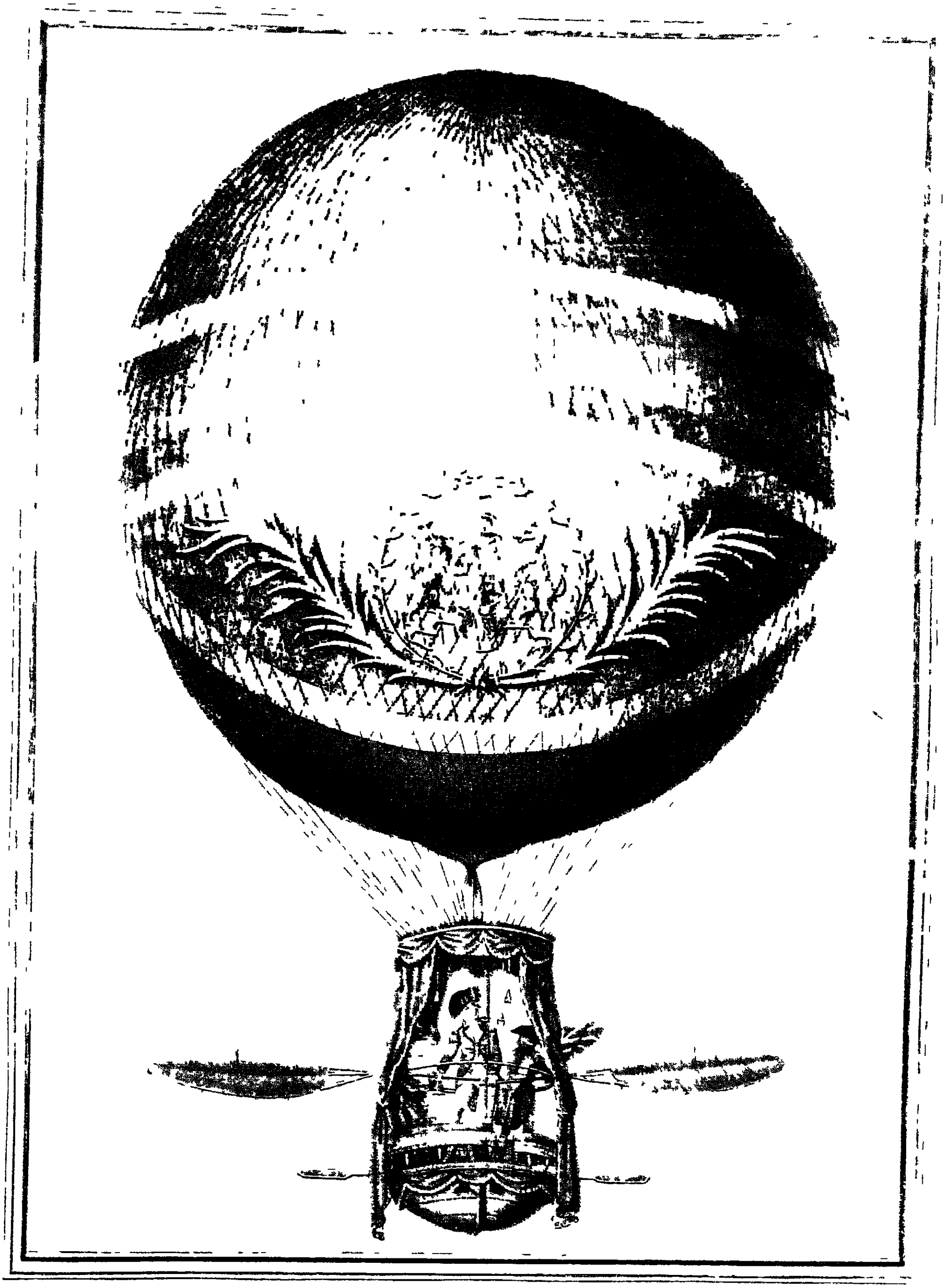


FIG. 27. LUNARDI'S SECOND BALLOON, 1785.

opposed on the score of imminent danger. Owing to the continuance of high winds the ascent was postponed to August 8th, and during the interval Lunardi was occupied in securing the safety of the balloon, for which purpose he erected sails affixed to masts as a means of affording some measure of protection. But the wind showed no signs of abating, and in a distressed state of mind Lunardi decided to sleep overnight on a chair within the fort.

[Midnight. August 8, 1785.]

'SLEEP flies to the humble Cottage, and seals the Eye-Lids of the unambitious PEASANT; on his Straw-Bed he slumbers happy, without a Care to break his Repose! what an enviable Condition! yet my Soul was never form'd to enjoy it: often have I said I will seek PEACE in RETIREMENT; but the glittering PHANTOM GLORY, has darted across my Path, and I have pursued it as eagerly as ever! it is a false Light, an *Ignis fatuus*, that leads me into many a melancholy Situation: and yet perhaps To-morrow's Dawn will see me following it with redoubled Ardor; and these serious Reflections will be forgotten: indeed I believe they are inspired by the Gloominess of the Night; for the Wind roars horribly, as if a thousand Demons were hurrying to Destruction on every Blast! the Waves break against the Foot of the Wall, with an hidious Noise; and the Sky is enveloped in deep Darkness. The ceaseless howling of the Storm plays with too great Force, upon my Heart Strings, to produce a soothing Harmony: and yet I fain would Rest; for tired Nature, harrassed with unremitting Fatigue, demands some Relief.

Tuesday Morning, Half-past Two.

I have been dozing a Little and, when I awoke, turning my Eyes to the Window, the first Object that saluted them was a BRIGHT STAR peeping thro' the Gloom; what a Comfort, at this Time, to see one of HEAVEN'S ETHERIAL LAMPS shine so clearly! I blest it as a cheering Messenger of better Weather! The Wind is not quite so violent as it was two Hours ago, and the Beams of the Star are, to me, Rays of Hope that illumine my clouded Prospects, and give me a distant View of Happiness.'

Owing doubtless to increased experience, the inflation, or as Lunardi called it, 'the Chemical Part of the Business', was more efficiently performed than heretofore, and by about 2 p.m. everything was in readiness.

'No sooner', the narrative continues, 'was the BALLOON unsheltered than, being exposed to the Vehemence of the Wind, it dragged the three Gentlemen almost to the opposite side of the FORT; which Circumstance alarming the Company, they immediately ran towards it in vast Crouds, and, to keep it steady, caught at the Netting, which they almost tore in

Pieces, and, by some Means or other, burst the BALLOON. Female Screams, and the Cry of " Don't let him go up, Don't let him go up ", now resounded from every Quarter. In vain did I call out to them to set me free; my single Voice was drowned by the Cries of the Multitude, and I saw no Probability of ascending: my Feelings, at this Moment, were so complicated that I almost lost the Power of Utterance and could only exclaim OH DIO! The INVOCATION was heard, and Heaven lent me its inspiring Aid: I started up, and, drawing my HANGER, swore I would cut every Hand about the Hoop; in saying this I perhaps threatened some of my best Friends, but I hope they will pardon me. If I had not gone up the People, in the FORT, would probably have been satisfied; but the many Thousands on the Outside what would they have said or done? therefore, however my Conduct might appear, it proceeded entirely from that Strength of Honour, which commands me above Friendship; and I trust all those who know me will not be angry with One who ever prefers his GLORY to his LIFE! My Threats had the desired Effect, I was immediately set free; and, swifter than a Rocket, darted into the Air at fifty-two Minutes past three o'clock. My first Thought looking down at the People below, was, Now follow me and pull me back if you can. I had put about Sixty Pound Weight of Ballast into the Boat, which I might have taken up, but, in the Confusion, when dragged about the FORT, it was thrown out, therefore you may judge with what Velocity I ascended, when you consider the Rising Power of the BALLOON. In about four Minutes, I lost Sight of LIVERPOOL; this Interval I employed in fastening the broken Strings, and waving the Flag as a Signal of my Safety, which I am sure gave great Satisfaction to many who were Anxious on my Account. . . . At five o'clock, I descended in a Corn-Field near Tarporley, and, from thence, by the Impetuosity of the Wind, was dragged a considerable Way, over Hedges, Trees, and a small Village, called TIVERTON, where the Balloon struck against a House the Chimney of which it pulled down; at last I succeeded in securing it, with the Assistance of several People, in a Lane half Way betwixt BEESTON CASTLE and TARPORLEY, though not till my Back was much hurt and my Limbs sadly bruised. I was carried in my Boat, with the Flagg flying, to Swan Inn TARPORLEY, where I dined with several Gentlemen who had come to meet me; the Bells rang all that Evening, and the next Morning while I set out for CHESTER, where I arrived at half after One o'clock, and was received with uncommon Applause, surrounded and carest by all the Gentlemen, especially those who were Witnesses of my Ascension from Liverpool.' [1]

At Chester he stayed for two days, and on returning to Liverpool was received a mile out of the town, to find himself carried in his ' boat ', midst the ringing bells and cheering crowds, on the shoulders of some of his most enthusiastic admirers. As he was again a loser by the ascent a subscription was opened, while a special

[1] Tissandier (vol. i, p. 110) erroneously connects this landing with Biggin's ascent from St. George's Fields on June 29.

though anonymous appeal to the 'Ladies of Liverpool' appeared in the press. A similarly practical act of homage was undertaken at Chester, and in return Lunardi promised to make an ascent there before the end of August. For some unknown reason this was not carried out, though Lunardi did make an agreement with Thomas Baldwin to allow the latter the use of his balloon for a day early in the month following. Baldwin, of whom nothing is known beyond his printed account of the ascent published at Chester under the title of *Airopaidia,* was interested in ballooning as far back as 1783, as may be gathered from a reference in his book to the small 'aerostatic globe' (released as a pilot balloon on the present occasion), in the performance of which 'little work' he states he was 'the sole Projector, Architect, Workman and Chymist'—a form of words apparently quoted verbatim from Cavallo's application of them to James Sadler.

Baldwin's Ascent at Chester, Sept. 8, 1785

The ascent was arranged for September 7th, but owing to a high wind Baldwin, at Lunardi's express desire, reluctantly postponed it until the day following. Lunardi (who superintended the inflation) having released the small 'globe' launched to ascertain the direction of the wind, the balloon—with a total weight of 420 lb., including 56 lb. of ballast—rose from Chester Castle Yard soon after 1.30 p.m. After being in the air for nearly two hours, during which time the balloon was carried by varying currents in different directions, Baldwin landed near Frodsham, about twelve miles from Chester. Reascending he finally alighted in a perfect calm, as lightly 'as the down of a thistle', in the middle of Rixton Moss, five miles NNE. of Warrington, after a journey occupying in all 'two hours, and a Quarter, within two Minutes'.

Baldwin's *Airopaidia,* 1786.

The precision of Baldwin's time-keeping is characteristic of his verbose and tedious account of the voyage, which he wrote—as the dedication conveys—at the request of the 'Principal Inhabitants of Chester'.[1] He complains that previous accounts of aerial voyages had been 'in many respects, vague and unsatisfactory', and that the failures—which ought to act as a 'spur to ingenuity', driving it forward to perfection, 'till airostatic ships make the Circuit of the Globe'—had been mistakenly omitted. Further, he comments on the fact that 'Balloon-Voyagers have likewise been particularly defective in their Descriptions of aerial Scenes

[1] Baldwin (T.), *Airopaidia: Containing the Narrative of a Balloon Excursion from Chester, Sept. 8, 1785, from Minutes made during the Voyage,* 1786, p. 8. Cf. Cavallo, p. 177.

and Prospects', and intimates that his own record is addressed to the general reader and not to the curious or philosophic only. On these lines Baldwin's account of the 'excursion' extends over nearly one hundred and sixty pages, and consists largely of rapturous descriptions of scenic effects above and below the clouds. In a typical passage he describes in a style which is the more stilted from being throughout in the third person, how 'a Tear of Pure Delight flashed in his Eye! of pure and exquisite Delight and Rapture', on glancing down from the car for the first time on the scene below, and it is with relief that the reader comes to Baldwin's brief note, made 'swiftly' on finding that the balloon was descending too rapidly, 'No more remarks, mind the ship'—meaning the balloon, as he is careful to add for the benefit of the 'generality' of his readers. His passion for detail is shown in the inventory of between twenty and thirty articles which he took in the car, e. g. 'An Asses Skin Patent Pocket-Book, as Wet spoils paper; Two red Lead Pencils, each Pencil ready pointed at both Ends, to save Time and Trouble; Two Needles with large Eyes, the raw Silk put through . . . to be ready at the Instant wanted, to sew up any Holes within Reach in the Balloon', and so forth. The second half of the volume is taken up with exhaustive hints on the improvement of balloons in direction, &c., mode of inflation by steam, inquiries into the state of the atmosphere, with various philosophical observations and conjectures.[1] Finally, there are extensive tables of barometrical pressure and the like. On the whole the book, though by reason of its early date not without interest, is lacking in scientific knowledge and precision, and Baldwin's enthusiasm for the subject fails to disguise the crude and 'amateur' character of his observations and conjectures.

Lunardi in Scotland, Sept. 1785.

Within a week of Baldwin's ascent Lunardi had travelled on to Edinburgh—where he arrived on September 12th—drawn thither partly by reason of the sincere friends he had found amongst Scotchmen in England, and partly by the 'inspiring thought' of being the first aeronaut in Scotland. His attractive personality appears to have made a ready appeal to men of distinction in the ancient capital, and within a fortnight Lunardi—with the help of Henry Erskine, who had been Lord Advocate of Scotland in 1783—had arranged for an ascent from George's Square on October 5th. His hopes, however, were destined to be disap-

[1] See note at p. 251 as to Baldwin's suggestion of the 'trail-rope'.

FIG 28. MRS. SAGE.
The First Englishwoman to ascend in a Balloon.

FIG. 29. VINCENT LUNARDI
The First to make a Balloon Ascent in England.

pointed owing to the opposition of a lady resident, but after some little delay he obtained permission, thanks to the good offices of Sir William Forbes, to ascend from the gardens of Heriot's Hospital.[1] But again Lunardi was plunged into despair owing to the slow transit (over ten days from Liverpool) of his hydrogen ' apparatus ' —' the airy Vehicle ', as he facetiously termed his balloon, having previously arrived—and eventually he was obliged to get a plumber to make two lead cisterns, 14 feet long, 4 deep, and 4 wide, for use in place of barrels. The usual exhibition of the balloon had meanwhile been held in the Parliament House, and excited great interest, though Lunardi's own egotistical account suggests that his personality proved the stronger attraction, at least to the ladies of Edinburgh, three of whom expressed a desire to accompany him on his first venture.

First Ascent in Edinburgh, Oct. 5, 1785.

On the afternoon of the appointed day Lunardi, amidst unparalleled excitement, and with characteristic disregard of the south-westerly wind—except in so far that he affixed eight bladders to the car, and accepted from Dr. James Rae, an eminent surgeon in Edinburgh, the use of a cork jacket—set off on what he subsequently called the most remarkable voyage he had made hitherto. Ascending with ' a considerable rising power, in order to clear the buildings ', Lunardi unfurled a large flag attached to a cord 300 feet long, by means of which he was able a little later to perceive ' two contrary Currents of Air '. Carried over the Firth of Forth, in the course of which he enjoyed a magnificent view extending to Glasgow and Paisley, the balloon descended almost to the water when two miles from the opposite shore, but on releasing a whole bag of sand it ascended rapidly, the barometer falling from 29 at the moment of departure to 18·5. Eventually it was carried over the land and alighted gently near the village of Callinge, near Ceres, and about three miles south-east of Cupar, after a voyage of forty-six miles (thirty-six of which, for the first time in Lunardi's experience, were over water, and the remaining ten over land) accomplished in thirty-five minutes. Next day, after the ladies of Cupar had vied with each other in repairing the torn neck of the balloon, Lunardi was presented with the Freedom of the Town, and on proceeding to St. Andrews (where the same ceremony was

[1] Sir William Forbes of Pitsligo (1739–1806), the friend of both Boswell and Johnson, was a distinguished banker. His portrait appears in the ' Group of Aeronauts ' in Kay's *Portraits*, no. 38 (Fig. 16).

repeated) he enjoyed an even greater honour in being elected a member of the 'Society of Gentleman Golfers', in whose 'diversion'—as he quaintly termed the 'Royal and ancient game'—he found some amusement. Returning to Edinburgh, the Freedom of the Capital was conferred on him as a testimony of the Common Council's appreciation of his undaunted courage in making this first aerial voyage in Scotland, despite a wind which manifestly threatened to blow him over the German Ocean.[1]

Ascends from Kelso, Oct. 21, 1785.

On October 16th, having been invited by the Caledonian Hunt to visit Kelso, Lunardi set off thither, having dispatched his balloon and apparatus in advance. His visit was enlivened by the races, which afforded him the keenest pleasure and of which he gives a vivacious description in his subsequently published *Account of Five Aerial Voyages in Scotland.* Five days later he ascended from the churchyard, wearing a scarlet uniform, his car being ornamented with pink silk, fringed with gold lace. After an hour and twenty minutes, during which he travelled twenty-five miles and claimed to have ascended to 7,700 feet, he came down on approaching the sea coast, and 'anchored on Doddington Moor', four miles from Wooler. Owing to the fears of the country-folk Lunardi had some difficulty in obtaining assistance, but eventually he induced them to draw the balloon—in the car of which he remained—towards Berwick. The wind freshening a little later the men were unable to hold the balloon, which was thereupon hauled down, deflated, and carried to the house of the owner of Barmoor, with whom Lunardi lodged for the night, returning next day to Kelso.

First Ascent from Glasgow, Nov. 23, 1785.

When he arrived once again in Edinburgh he found an invitation awaiting him to visit Glasgow, where he was subsequently received with great enthusiasm. No difficulties being encountered, an ascent was made on November 23rd from St. Andrew's Churchyard, the balloon having been on exhibition, 'by the desire of many principal inhabitants, in the Old Church Choir'. The balloon, inflated with great dexterity, rose slowly in view of 100,000 spectators; but on Lunardi throwing out consecutively three bags

[1] A more doubtful honour was that conferred by the Most Ancient Order of the Beggar's Benison and Merryland (a convivial society, with erotic characteristics, founded at Anstruther, Fife, in 1739), who created 'Vincent Lunardi, armigerum lucaensis', a knight companion. It was probably at his initiation in this Order that he proposed the toast of 'Lunardi, whom the ladies love', sometimes cited as evidence of egregious vanity.

of ballast, it ascended with great rapidity, and was carried in a brisk south-westerly gale at an 'immense velocity'. Passing over Hamilton—at which time he was computed to 'have been flying at the rate of forty miles an hour'—and Lanark, Lunardi relates that being extremely fatigued he laid down in the bottom of the gallery and slept for twenty minutes. As a precaution against any danger involved in this risky if soothing situation, he fastened 'a small stillyard[1] to a piece of rope, and this to the neck of the balloon', so that when the envelope became flaccid during the descent the stillyard would fall across his face—an expedient which he records was quite successful. After being in the car about an hour and a half, Lunardi made a first attempt to land on high ground, but the wind was too strong, with the result that the cable broke and he lost his anchor. Again ascending above the clouds—which he strangely describes as presenting 'the very same shape as the hills below'—he eventually descended 'as light as a feather' between two hills near Alemoor in Selkirkshire.

The second ascent in Glasgow took place on December 5th and was also made from St. Andrew's Churchyard. A high wind caused Lunardi considerable alarm, and though not himself deterred he refused to take up a Glasgow boy as he had agreed to do. Moreover, in reply to the request of Captain Barns to take the boy's place, Lunardi records his reply to the effect that on that day he would not send up any friend of his 'for all the gold in the world'. Apparently his fears were justified, for he had an exciting and dangerous voyage. Soon after the ascent he found the car had not been properly secured, and subsequently described it as being 'almost overturned', so that in exceeding alarm he was obliged to hold on to the upper hoop. The voyage on this occasion only lasted something under half an hour, at the end of which the balloon fell rapidly and landed at Easter Mockroft, near Campsie, about nine and a half miles NNE. of Glasgow. The car struck the ground with such force that it was broken in two, but the aeronaut, by suspending himself 'to the upper part of the gallery', escaped with nothing worse than 'a very violent shock'. The same evening Lunardi returned to Glasgow, and the next day set out for Edinburgh to fulfil his undertaking to make a second ascent from that city.

Second Glasgow Ascent, Dec 5, 1785.

[1] An obsolete form of steelyard, i.e. a balance used for weighing.

Second Edinburgh Ascent, Dec. 20, 1785.

It was Lunardi's intention on this occasion to add novelty to his second venture by 'ascending with two balloons', one above the other. The upper one, made under his own direction by the girls of the Merchant Hospital, was 10 feet in diameter, and was intended to float 550 feet higher than that beneath which he ascended, the idea being 'to ascertain the different currents of air'.[1] The weather on the appointed date, December 19th, proving foggy and wet, the experiment was deferred; but the next day, despite a south-westerly wind, Lunardi, in the uniform of the Scots Royal Archers, rose for the second time from the grounds of Heriot's Hospital, having previously attached several bladders and pieces of cork round the car. He records that within three minutes the balloon was perpendicularly over the Firth of Forth, but there was not much wind, so that by about two o'clock—nearly an hour after leaving Edinburgh—it had not cleared the land which projects in the neighbourhood of North Berwick. Unable to effect a landing, he soon after touched the surface of the water about a mile or so from the Fidra rock, but he was under no apprehensions, as the balloon, acting like a sail, 'made way very fast' towards the Isle of May (on the north side of the Forth), near which he could distinguish three vessels under sail. After being dragged through the water for something like two hours—during which time Lunardi was clinging to the hoop with the water often breast-high—he was rescued by a fishing-boat, the occupants of which, directly the distressed aeronaut got aboard, let go the balloon.[2] A revenue boat soon after came up, when, with admirable sincerity and manliness, Lunardi refused the offer of the king's officers to go on board, in order to show his gratitude to the people who had rescued him, and by whom he was landed near North Berwick about 5 o'clock. On returning next day to Edinburgh he found a subscription had been opened to furnish a new balloon—an offer he gratefully refused, partly in the belief that his balloon would be recovered, and partly because he felt he was already sufficiently indebted to the inhabitants of the ancient capital.[3]

[1] As a matter of fact Lunardi makes no further reference to this 'double ascent'—doubtless he found it an impracticable idea. But the same girls also made a model of a larger balloon without any valve, which he claimed was 'so contrived as not to burst even though it would ascend with 100 pounds of rising power'.

[2] The balloon was picked up next day by the 'May' cutter twelve miles from Anstruther off the Fifeshire coast (Kay's *Portraits*, 1837–8, no. 36).

[3] Lunardi printed a record of his northern exploits under the title of *An Account of Five Aerial Voyages in Scotland in a Series of Letters to his Guardian, Chevalier G. Com-*

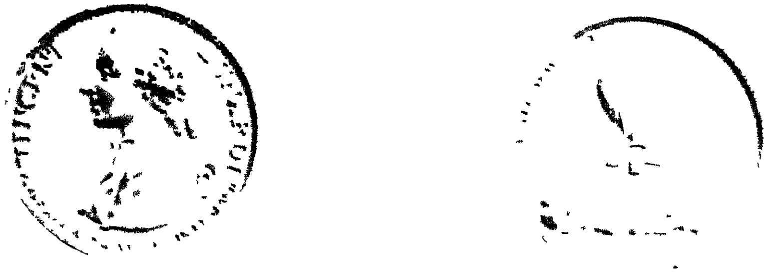


FIG 30 Medal to commemorate Lunardi's First Ascent, 1784.

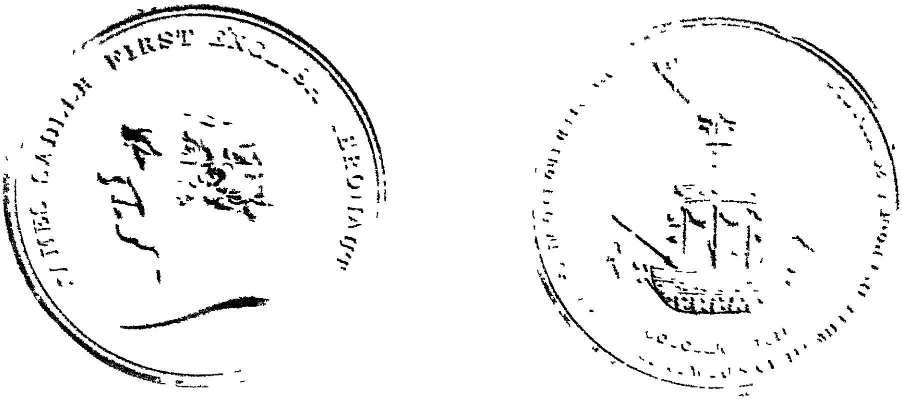


FIG 31 Medal of James Sadler's Ascent from Birmingham, 1811.

FIG. 32. Bronze Token commemorative of Sparrow's Ascent with Green, Oxford, June 23, 1823.

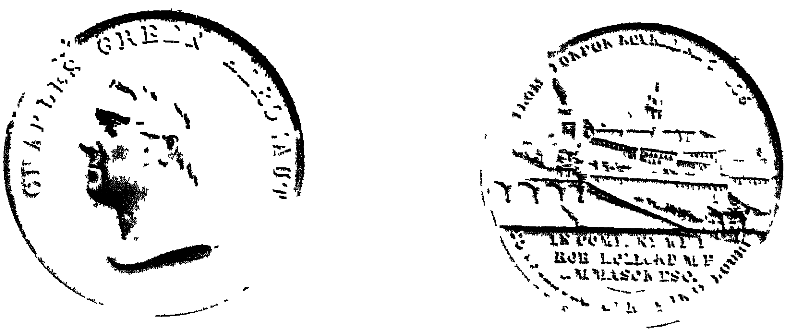


FIG. 33. Medal of Charles Green's Aerial Voyage to Weilburg, 1836.

In the following year Lunardi visited Dublin, but apparently his reception did not encourage him to undertake an ascent. During the summer he paid another visit to Edinburgh, and on July 31st made a solo ascent from Heriot's Hospital, though had the lift of the balloon allowed, Mrs. Lamash, an actress, was to have accompanied him. It was presumably on his return from Scotland that he stopped at York, where he made an ascent from Kettlewell's Orchard behind the Minster. As usual the ascent was timed for about 1 o'clock, and it is said that on this occasion Lunardi inflated the balloon in less than twenty minutes. Being the first event of the kind at York the ascent created great interest—it was described as being 'truly sublime', the balloon rising to a 'prodigious height'. An hour later, having experienced very inclement weather, during which he passed through electrically charged clouds, Lunardi essayed to land; but apprehensive of doing injury to some fields of corn, he reascended, and finally came down near Greenock, a village in the parish of Bishop Wilton, about eighteen miles from York. On his return late the same evening he was greeted by vociferous crowds, who took the horses from his carriage and drew him in triumph through the city.[1]

Third Edinburgh Ascent, July 31, 1786.

Ascent from York, Aug. 23, 1786.

Rather less than a month later Lunardi was at Newcastle-on-Tyne, where an ascent arranged for September 19th from Spital Ground was prevented by an unfortunate and fatal occurrence. From Lunardi's own account it appears that during the inflation—the process had taken about an hour and a half and the balloon was only one-third filled—some accident happened to the gas-making apparatus, whereupon a number of gentlemen who had hold of the guide-ropes suddenly let go. The balloon thus released rose with great velocity, carrying with it, to the consternation and horror of the assembled crowds, a young man named Ralph Heron, who had twisted round his arm a strong rope intended for use with the anchor Lunardi carried in the car. Unable to free himself, Heron was carried up above the height of St. Nicholas's Church steeple when the rope gave way and he fell upon a flower-bed,

Misfortune at Newcastle, Sept. 19, 1786.

pagni, 1786, at the end of which were printed the verses by James Tytler. The book was reprinted in *Astra Castra*, but Hatton Turnor, evidently unaware of the Liverpool ascents, was wrong in calling this the 'second series' of letters.

[1] On the occasion of Blanchard's ascent from Nuremberg in November 1787 the French aeronaut enjoyed the same honour at the hands of his German admirers, a small print of the incident being afterwards published, headed, 'Blanchard's Retour, nach englischer Weise'.

with such force, it is said, that he sank knee-deep in the soft mould. Though able to speak a few words to his father and mother, who were distressed witnesses of the fatality, he died within a short time—the first victim of the balloon in England. Lunardi, doubtless sincerely affected by Heron's untimely death—'I have never suffered so much since I was born', he wrote in a letter to a friend—was obliged to make good his escape from the fury of the populace.

Whether or not as the result of this accident cannot be known, but it does appear to be the fact that Lunardi—who was characterized by incensed Newcastle journalists as an 'audacious adventurer' seeking to fill his pockets at the expense of the foolish curiosity of 'gaping crowds'—made no further ascents in England.[1] In June 1787—the year following—he was engaged in experimenting with an invention for life-saving at sea, the merits of which he sought to demonstrate by an exhibition in the Thames at Battersea. In August he left England for France, subjecting his life-saving apparatus to a more severe test off the French coast near Calais. Passing through Paris he returned to his native country, where for the next few years he renewed his aeronautical experiences, making ascents from Rome in 1789, from Palermo (where he fell in the sea) in 1790, and twice from Naples in the presence of the King—the ascent on August 24, 1791, resulting in another immersion. At a later date he made a series of remarkable ascents in Spain, where he was also patronized by the King, and made several ascents from Madrid, the first being from the Retiro Garden on August 12, 1792. In January of the next year he made three ascents from Madrid in one day, and others from Canada Larga and Horcajo, on landing at which latter place he was taken by the peasantry to be a saint fallen from heaven and carried in triumph to the local church—an experience possibly not distasteful to Lunardi's egoism.[2] In 1794 he was in Portugal and ascended for the first time from Lisbon on August 24th of that year. But probably by this time his health was failing, for he never returned to Italy, and died of a decline in a convent at Barbadinas, Lisbon, on July 31, 1806.[3]

His Ascents on the Continent, 1789–94.

[1] Between 1785–7 Lunardi evidently experienced hard times—in 1785 he was caricatured as 'The Itinerant Aeronaut, or Aerostation out at elbows', and at one time (to judge from the evidence of a printed card) he was occupied as a hotel keeper.

[2] See Tissandier, p. 111 *et seq.* and Boffito, cap. XVII.

[3] Cf *Gent. Mag* 1806, ii, 875 (quoted in *D N B*), and Tissandier, vol. i, p. 114.

Though it is perhaps too much to claim that Lunardi 'takes a high place among pioneers of Ballooning', it cannot be denied that he is a prominent figure in the early annals of aerostation in England, while his exploits undoubtedly encouraged the vogue of ballooning in those early days. But his lack of scientific training and his passion for achieving personal success rendered such observations as he made of little practical value, and despite numerous and varied experiences he made no serious contribution to the technique of ballooning. On the other hand his undeviating courage in aeronautical exploits, undertaken in days when ascents were fraught with no inconsiderable dangers—dangers the greater for the very reason that they were so imperfectly understood—must ever perpetuate his name in the country in which he first achieved success, and which (in his own words) was his 'by a species of adoption'.[1]

[1] See Dedication to Lunardi's *Aerial Voyages in Scotland*, 1786. In this connexion it is notable that Lunardi's name appears in the *D. N. B.*, vol xxxiv (where the above-mentioned claim respecting his place as a pioneer is made), though he was Italian by birth and only lived in England about five years.

CHAPTER VI

THE FIRST ENGLISH AERONAUT, JAMES SADLER, AND HIS SONS

THOUGH to Vincent Lunardi belongs, strictly speaking, the honour of being the first to ascend from English soil, to James Sadler belongs the equivalent honour, not heretofore sufficiently recognized, of being the first Englishman to engage in ballooning enterprises with enthusiasm and thoroughness. The actual date of his first ascent has been—as discussed in the following pages—the subject of controversy, but that in no way affects the early date and general character of his endeavours, of which (as far as the writer is aware) no adequate record exists.[1] James Sadler was born in 1751, probably in Oxford, where in later years his family carried on a well-established business in the High Street as confectioners.[2] Doubtless he himself was brought up in the business, as may be gathered from some punning verses in which Sadler is set up as a rival to Lunardi—

Born in 1751.

> Behold a windy competition,
> Two puff-makers in opposition,
> The whole must end in vapour.
> By various means their puffs they utter,
> This uses water, flour and butter,
> And that pens, ink and paper.[3]

His First Aerostatic Experiments, Oxford, Feb. 9, 1784.

Nothing is known as to how Sadler first became interested in aerostation; but it must have been early in 1784, for on February 9th

[1] The account of Jas. Sadler in the *D. N. B.* (vol. l, p. 112) appears under the name of his son Windham, though there is reason to regard the father as the more remarkable man. Hatton Turnor (p. 78) is characteristically content—no other information being readily accessible—to quote Cavallo's reference to 'one Sadler', without any addition save the mention of two ascents in 1811–12. In other books the elder Sadler, if not ignored, is often confused with his sons John and Windham

[2] See entry in Pigot's *New Universal Directory*, 1791–8, vol. iv (Oxfordshire), p. 154, 'Sadler (Thos) Pastrycook and Confectioner'. A similar entry appears in a later edition (about 1830), 'Sadler (Chas. James), Confectioner, High Street'.

[3] From a collection of cuttings (dated 1785, &c.) in the library of the Royal Aeronaut. Soc. Lunardi's effusive literary efforts were the subject of some not wholly deserved ridicule. Sadler, on the contrary, seldom used his pen. A contemporary reviewer stated that a 'few minutes conversation with Lunardi will convince any one that he did not write a single page of this narrative [of the *First Aërial Voyage*, 1785]'.

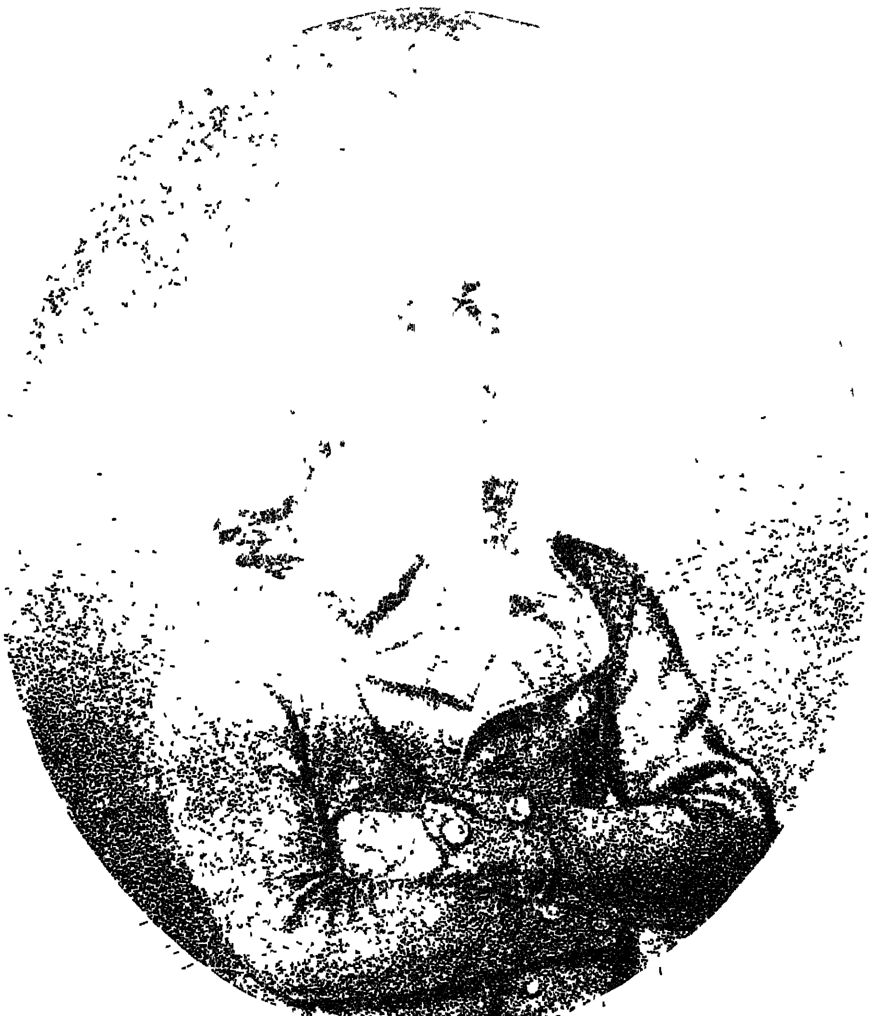


FIG 34 JAMES SADLER OF OXFORD.
The First English Aeronaut.

of that year he launched a 'Montgolfière' balloon at Oxford 'before a great concourse of people', and in so doing 'received the approbation of the whole University, to whom he gave the utmost satisfaction'. Later in the same month he constructed 'with great labour and expense' a larger 'hot-air' balloon—63 feet in circumference—which was exhibited in the Town Hall, while at the end of March he announced that he would exhibit another balloon 'on a different principle'—that is to say inflated with hydrogen gas. After various other experiments which, regarded in conjunction with the fact that he tested both 'Montgolfière' and 'Charlière' types, bear witness to his enthusiasm, Sadler appealed in July for subscriptions to enable him to build 'a large Aerial Machine'. In renewed appeals made during September, he added that he proposed to undertake experiments at various elevations on the 'Rareness and Density' of air, a subject which at that time afforded scope for scientific speculations. Meanwhile he apparently constructed yet another 'Montgolfière', designed on a sufficiently large scale—170 feet in circumference and with 38,792 cubic feet capacity—to carry one or more aeronauts. In accordance with the ideas of the time Sadler fitted oars to the gallery or car of the balloon, by means of which he hoped to be able to 'increase the motion'.

It was with this balloon, if we accept the circumstantial account of the exploit which appeared in *Jackson's Oxford Journal*, that Sadler achieved his first ascent. In view of the doubts raised as to the occurrence, the contemporary narrative is here printed verbatim. His First Ascent, Oct. 4, 1784

'Early on Monday Morning the 4th instant, Mr. Sadler of this City, tried the Experiment of his Fire Balloon, raised by means of rarefied Air; Underneath was fixed a Kind of Gallery, provided with a Stove suspended over it for containing the Fire, so contrived, by a Movement, as to let in any Degree of Heat for the Expansion of the Machine.[1] The Process of filling the Globe began at three o'Clock, and about Half past Five all was compleat, and every Part of the Apparatus entirely adjusted. The enclosed air having undergone a sufficient Degree of Rarefaction, Mr. Sadler, with Firmness and Intrepidity, ascended into the Atmosphere, and the Weather being calm and serene, he rose from the Earth in a vertical direction to about the Height of 3,600 Feet. The Barometer, which at the Beginning of the Experiment marked 29 inches and ½, now stood at 25 Inches and five Lines, the Mercury having gradually fallen during his Ascension. In this elevated Situation he perceived no Inconvenience; and, being disengaged As recorded in the *Oxford Journal*, Oct. 9, 1784

[1] Sadler's 'hot-air' balloon is thus pictured in an engraving published by J Marshall in May 1785. See Banks Collection in the British Museum.

from all terrestrial Things, he contemplated a most charming distant View; With Pleasure and Admiration he beheld the Surface of the Earth like a large and extensive Plain, and felt himself perfectly agreeable, having experienced no remarkable Change in the Air, except a slight Degree of Cold which was easily supportable. At this immense Distance it was impossible with Certainty to judge of the true State of the Air, the Thermometer having so close a Connection with the Fire in the Grate as to be of no Service for the Purpose of Observation. Upon shutting the Stove, the Balloon descended with a slow Motion, the Space of a few Minutes, but suffered no other Alteration than the successive Modification of Extension and Compression. At this Instant a light Breeze suddenly arose, which drove the Machine with great Rapidity in an oblique Direction. Examining the Barometer at this time, he observed that the Mercury had risen to 27 Inches, and from this Circumstance concluded the Machine had descended 1,350 Feet from its highest Elevation. The Power of ascension was now considerably diminished, and therefore to raise the Machine to the same Height as before, it was proper to increase the Expansion by enlarging the Fire, that the Heat might be more equally communicated. In attempting to effect this Purpose, he had the Misfortune to drop the Fork; this Loss was irreparable, and obliged him to quit the Design; otherwise his Intentions were to direct his course for Woodstock. In these Circumstances, advancing with an accelerated Motion, and perceiving that he approached a Wood, it was absolutely necessary to have Recourse to the Oars, which he exercised with great Success: and the Force of Ascension being again considerably increased, he had a perfect Command of the whole Machinery, and found it extremely easy to regulate, and to alter his Position while the Air remained calm. After floating for near Half an Hour, the machine descended, and at length came down upon a small Eminence betwixt Islip and Wood Eaton, about six Miles from this City.' [1]

Seeing that this event took place fourteen days before Dr. Sheldon's ascent with Blanchard from Little Chelsea, the distinction of being the first Englishman to ascend in a balloon from English ground appears undoubtedly to belong to Sadler.[2]

Cavallo's Denials, 1785.

Doubts as to the accuracy of this account were first raised by Cavallo, who in his *History of Aerostation* dismissed it as unauthoritative on the ground that 'after strict enquiry it was found that nobody saw [Sadler] either ascend or descend'.[3] The weight of

[1] *Jackson's Oxford Journal* [Weekly], no. 1641, Oct. 9, 1784. There is a file of this paper in the Bodleian Library. The account quoted was copied, with variations, in other newspapers of the day.

[2] Cf. Cavallo, p. 176; *Brief Account of the Origin of Aerostation*, printed at Ludlow, without date (Patent Office Collection, vol. viii, fo. 155); Forster, p. 22; Monck Mason, pp. 274–5; and *Astra Castra*, pp. 77–8.

[3] Cavallo, p. 176. 'The first English Aerostatist' (as he was subsequently termed) is here referred to a little contemptuously as 'one Mr. Sadler'. Cavallo enforces his disbelief of the date, Oct. 4, by stating that Sadler 'really ascended' on Nov. 12.

Cavallo's denial, regarded in the light of his opportunities for obtaining first-hand information, cannot be disregarded, even though it stands alone—for all subsequent doubts or denials were apparently based on Cavallo's statement. On the other hand the *Oxford Journal* was, even in 1784, an old-established paper, and of a character not likely to countenance a bogus narrative. Moreover, in the same columns there appeared the renewal of Sadler's appeal to the inhabitants of Oxford, and it is hardly conceivable he would have incurred the risk of damaging the reputation for honesty and ability he had already earned, by allowing a fictitious report to pass without denial. Further, an account of the 'excursion made at Oxford by a Mr. Sadler in October, 1784' (abbreviated from that above quoted), was published by George Urquhart, a contemporary scientific writer, and the author of *Institutes of Hydrostatics*, 1786. To this treatise he appended a 'Philosophical Essay on Air-Balloons', with 'Abstracts of the most interesting Accounts published of Air-Balloon Excursions', and though it is a little strange he does not also mention Sadler's ascent on November 12th, his corroborative authority may be quoted inasmuch as his essay reveals that he had no faith in balloons.[1] Monck Mason, at a later date, found no reason for disbelieving the contemporary account, though the reply he received in answer to an inquiry addressed to Sadler's son, John, does not exactly support the date above mentioned.[2]

One means of confirmation may perhaps be found in the fact that Sadler's flight from Worcester, on September 10, 1785, was described as his 'Seventh Aerial Voyage'. Taking the accounts of Sadler's ascents prior to that date, they may be tabulated as follows:

1. Oct. 4, 1784.	'Montgolfière' balloon, at Oxford.				
2. Nov. 12, 1784.	'Inflammable-air' balloon, Physic Garden, Oxford.				
3. May 5, 1785.	,,	,,	,,	Moulsey Hurst.
4. May 16, 1785.	,,	,,	,,	Manchester.
5. May 19, 1785.	,,	,,	,,	Manchester (2nd ascent).
[June 24, 1785.	,,	,,	,,	Corpus Christi College, Oxford.]
6. Aug. 25, 1785.	,,	,,	,,	Worcester.
7. Sept. 10, 1785.	,,	,,	,,	Worcester (2nd ascent).

[1] Urquhart (G.), *Institutes of Hydrostatics*, &c., 1786, p. 244.

[2] Monck Mason, p. 274, where John Sadler's reply is given to the effect that 'his father's first ascent (took) place at Oxford on the 12th of October (1784), from the gardens

The ascent on June 24th is purposely not counted because—as will be seen—Sadler, though responsible for the event, did not himself ascend. The above 'voyages' are all recorded in the *Oxford Journal* and elsewhere, and if the list is correct it is apparent that Sadler reckoned from October 4, 1784.[1]

His Second Ascent, Oxford, Nov. 12, 1784.

Sadler's second ascent at Oxford was certainly made from the Physic Garden on November 12th, and it evidently created great enthusiasm.[2] An immense crowd of all ranks thronged the streets, the buildings, the towers, the trees, and the fields adjacent to the place of ascent. The balloon and apparatus, 'with materials for exciting the inflammable gas', were placed in the centre of the garden, the inflation taking about two hours to complete.[3] About 1 o'clock Sadler stepped into the boat-shaped car, the balloon was released, and in three minutes had disappeared in the clouds, moving with great rapidity before a wind which 'blew pretty fresh from the south west'. Passing over Otmoor and Thame, Sadler was obliged to throw out all his ballast, instruments, and provisions, owing to a too rapid descent caused by the escape of gas from an aperture in the envelope. Finally he effected a landing at Hartwell, near Aylesbury—the journey of fourteen miles from Oxford being made in about seventeen minutes—though not until he had been dragged for a considerable distance over the ground, the balloon itself being totally demolished.[4] His success encouraged him to further ventures, including a projected attempt to cross the English Channel from Dover, a feat which Sadler evidently hoped to be the first to accomplish. Apparently towards the close of 1784 he constructed a new balloon of silk—capable of remaining in the air for twelve hours—and consigned it, with the necessary

Sadler's projected Channel Crossing, Jan 1785.

of the botanical establishment belonging to that University'. But the ascent from the Physic Garden (now known as the Botanic Garden) unquestionably took place on Nov. 12. Monck Mason also mentions an ineffectual attempt made by Sadler on Sept. 12, but the writer could find no reference to this in the *Oxford Journal*.

[1] The *Oxford Journal* in recording Sadler's death in March 1828, again refers to his 'first ascent from this city on the 4th of Oct. in the year 1784'. The point is not of the first importance, but it is of interest, and the writer inclines to the view that Sadler did ascend, as alleged, prior to Sheldon.

[2] The poet-laureate of the day, H. J. Pye, celebrated the event in verse. See Ch. IX, p. 208.

[3] It is said that Sadler was the first to make use of a cistern (instead of casks) in the gas-making apparatus. See Southern (J.), *Treatise upon Aerostatic Machine*, 1785, p. 51.

[4] Sadler subsequently sold the balloon for £120 to Harper of Birmingham. The latter attempted an ascent from Oxford on Dec. 29, 1784, but 'egregiously erroneous' arrangements for inflation resulted in a fiasco and the reading of the Riot Act. For Harper's ascent at Birmingham in January 1785 see Ch. VIII, p. 193.

apparatus, for carriage by water to Dover.[1] Unfortunately the boat was held up in the Thames by severe weather for over a fortnight, and when at length Sadler received the envelope he found that owing to the freshness of the varnish the silk had stuck together in such a way that to inflate the envelope was impossible. Returning with it to London, he was greatly mortified the day before he again set out for Dover to learn that Blanchard—on January 7th—had already accomplished the crossing.[2] However, like a 'true philosophic genius', his enthusiasm for aeronautics was not checked by this disappointment. During the spring of 1785 he made several notable ascents, one from Manchester being of an hour and three-quarters duration, during which the balloon was carried by different currents and eventually came to earth within a mile of Bury. In a second ascent at Manchester (again from the grounds of the residence of J. Haworth) on May 19, Sadler attained an altitude of over 13,000 feet—higher than any of his former ascents—being above the clouds for three-quarters of an hour, suffering considerably from cold, respiration, and severe pain in the ears. Unable to operate the valve owing to the gear having frozen, the envelope was severely strained by the expansion of the gas; but having travelled over fifty miles Sadler landed at Pontefract, when he was again dragged over the ground for two miles and suffered considerable injuries. Eventually, unable to hold the balloon and being without help, he had to let go, and it was subsequently found in a field near Gainsborough.[3]

His Ascent from Manchester, May 16, 1785

Again on May 19, 1785

Prior to these two ascents at Manchester Sadler made one from Moulsey Hurst, on the Thames, on May 5, 1785, in which he had the distinction of being accompanied by William Windham, the statesman, at that time member for Norwich. In view of the risk he ran Windham not only made his will but wrote a letter of farewell to his friend G. J. Cholmondeley, only to be delivered in the event of his death. After apologizing for keeping his purpose secret, he proceeds to explain his motives, and in so doing makes an

From Moulsey Hurst, May 5, 1785.

[1] He is said to have worked on the project day and night and to have expended on it over £500 (cutting in Cuthbert Collection).

[2] Blanchard also forestalled Pilâtre de Rozier, who, undeterred however, made his fatal attempt on June 15. The incident has a modern parallel in the rivalry between Bleriot and Latham in the first Channel flight by aeroplane, accomplished by the former on July 25, 1909.

[3] The balloon was made of about 200 yards of silk, and the finder refused an offer of eight guineas for it (Cuthbert Collection cutting).

interesting reference to Sadler whose patron and friend he subsequently became.[1]

'Something, however,' he writes, 'must be said in case of the worst, that I may not leave the world without one affectionate farewell to him, who in the final evanescence of all worldly objects must be the last to remain upon my sight. . . . Some notice must be taken of a circumstance, which, however innocent, sits uneasy upon my mind, as it is a deception practised towards you. I mean the concealment from you of my present purpose, and the means by which I was obliged to effect the concealment. My motives to this you cannot mistake or be displeased at; and I think, will not condemn my determination. The hope that the news of my landing might, from the precautions of secrecy I have used, be the notice you would receive of my flight, prevailed over the wish of parting from you as my last earthly object, and of gratifying a similar wish, which I conceived would exist with you. Should you receive this letter I shall have wished that I had acted otherwise; should the event be as I hope, I shall be glad that I acted as I have. Something likewise must be said of my motives of this adventure. From the moment of my hearing of Balloons, I felt, in common I believe with many of the smallest imagination, the wish of adventuring in one, and as early as the beginning of the winter before last, concerted with Dr. Fordyce that we should build one and go up together. The dissolution of Parliament joined to my own and his dilatoriness delayed the execution of the purpose: till during my residence at Oxford in last September I got acquainted with Sadler; with whom I should then have gone up, but that before I knew him sufficiently to trust him with my intention, he had inserted an advertisement, which, as you may hear from a letter which I happened to write at the time to Legge, fixed him, he thought, to the necessity of going up at Oxford. I give you this detail, that you may vindicate me against the imputation either of doing this from ostentation, or of having chose to wait, till experience should have done away with any great apprehension of danger.'

The balloon took about two hours and a half to inflate, the car being suspended by fifty-three 'strings', and carrying—besides the two occupants, instruments, &c.—300 lb. of ballast. Shortly after the ascent (during which the balloon was observed to turn gently on its axis) it began so very rapid a descent that, fearing the envelope had burst at the top, Sadler released a large quantity of ballast in order to avert danger. There inevitably followed a

[1] William Windham (1750–1810), the friend of Dr. Johnson, subsequently held office as Minister of War and the Colonies in Grenville's Administration His keen interest in balloons is testified by entries in his *Diary*, 1866, pp. 3, 6, 36, &c., e. g. 'Feb. 7, 1784 . . . from (nine) till eleven, did little more than indulge in idle reveries about balloons'. On the birth of Sadler's younger son, William Windham Sadler, the statesman stood as godfather. See also *The Windham Papers*, 1913, vol. i, p. 75.

rise to a much higher altitude—Horace Walpole, who watched the balloon from Strawberry Hill, described it as looking 'not bigger than my snuff-box'—and this time Sadler found it necessary to cut the silk tube used for inflation, so as to allow of a quicker escape of gas. Passing over Southwark, Blackheath, and Dartford, and finding themselves in close proximity to the sea, it was deemed advisible to descend, but again misjudgment in the release of ballast led to the balloon rising to a still greater height, while a new device designed to take the place of a valve—'without its inconvenience'—failing to act, Sadler had to make further rents in the sides of the envelope.[1] Finally they descended near the confluence of the Thames and the Medway, when, through the carelessness of the countryfolk who assisted in the landing, the balloon (after Sadler and Windham had got out of the car) was allowed to escape.[2] Shortly afterwards it fell into the sea some four miles below the Nore, was picked up by an outward-bound vessel, and carried to Sunderland.

Sadler's next attempt on June 24th from the grounds at the back of Corpus Christi College, Oxford (in the presence of Dr. Horsley and other Fellows of the Royal Society), was not entirely successful, as the lift of the balloon proved quite insufficient to carry four passengers as intended. Sadler thereupon allowed Colonel Richard Fitzpatrick (Lord Ossory's brother) to ascend alone, and after being an hour in the air the balloon came down—owing to a rent in the envelope which was not noticed until after landing—near Kingston Lisle, opposite the White Horse Hills in Berkshire. As Fitzpatrick had never ascended in a balloon before, his exploit (though not unique) is remarkable, and his own account of his flight may be quoted as giving the impressions of one of the earliest amateur pilots.

Oxford, June 24, 1785.

'I have gratified my curiosity', he wrote a few days later to his friend Windham, 'in a flight from Oxford, where your protégé Sadler (who, by the

[1] The circumstances of this and other landings made by Sadler, indicate that the theory of ballooning was not at this period scientifically understood. It may in justice be added that Sadler's many severe experiences in landing were due in some measure to his courage in ascending in high winds

[2] Windham subsequently recorded in his Diary that though 'much satisfied' with himself, he was dissatisfied with his adventure, for had he realized the fear of danger would be so slight, he would have 'deferred going till we have a wind favourable for crossing the Channel'. See *Windham Papers*, 1913, vol. i, p. 76, where it is erroneously said that this was Sadler's last flight. The *D. N. B.* (vol. l, p. 113) errs contrariwise in referring to it as Sadler's first ascent.

by, I consider as a Phenomenon), behaved very handsomely, and finding his process not answer his expectations and the balloon only capable of carrying up one person, very obligingly gave me up his place, and after receiving some hasty instructions, I ascended by myself, in view of all the University, as well I believe of the whole county. Some of your friends there, Mrs Croft and Mrs Burgess, were particularly civil to me, and did their utmost to keep the spectators in order, but in vain, for the curiosity and eagerness of the crowd was not to be restrained. The thermometer was broken, and your barometer had a narrow escape. I ascended with 7 bags of ballast, the weight of which I did not then know, but which was about a hundred pounds. I had told Sadler that I would not take his balloon very far, and my intention was to have flown about two hours, but as I wished to ascend as high as possible without danger to the balloon, after having first try'd the valve to see if I was master of the use of it, I continued rising for three-quarters of an hour, when I suddenly perceived from my flag that I was descending. I discharged gradually five of my bags of ballast, throwing out papers between each, without finding that I appeared to diminish the velocity of my descent, till the 5th, when the paper I threw out floated instead of rising, to my great satisfaction, since I perceived something had happened of which I was ignorant. I then determined to reserve my two last bags till I was certain of being very near the earth, and fixed one of them to the anchor in order to drop it and break the fall of the machine. When I saw the shadow of the balloon increasing very fast, and could plainly distinguish objects, so small as horses in waggons and in the fields, I threw out my sixth bag, but unluckily when I was preparing the seventh upon the anchor, it slipp'd off, and fell without it. Within a very few seconds I came to the ground on the side of a steep hill, in a corn field. The shock was trifling but the unevenness of the ground overset the Car, and rolled me gently out. Disentangling myself from the cords, I held fast the side of the car, and with some difficulty held the balloon till some country people came to my assistance. I then perceived a large rent in the lower part of it, which accounted for my descent, and which, I suppose, by a more judicious use of the valve I should have prevented. The curiosity and astonishment of the country people who flocked in by shoals were prodigious. I got Sadler's balloon, however, safe in a stable, and waited at a little publick house two hours for his arrival. We were then conducted with great triumph about 5 miles to Wantage in Berkshire, where we dined, but as I did not admire this triumphal mode of travelling, I declined making my entry in to Oxford, and got on by myself as far as Henley, and came the next morning to London. The field where I descended was 20 miles from Oxford, and I was just an hour on the voyage. I shall endeavour to promote our grand project both for our own amusement, and I hope for the advantage of Sadler, whom I really consider as a prodigy, and who is oppressed, to the disgrace of the University, I believe from pique and jealousy of his superior science. Adieu, Dear Windham.' [1]

[1] *Windham Papers*, 1913, vol i, p. 76.

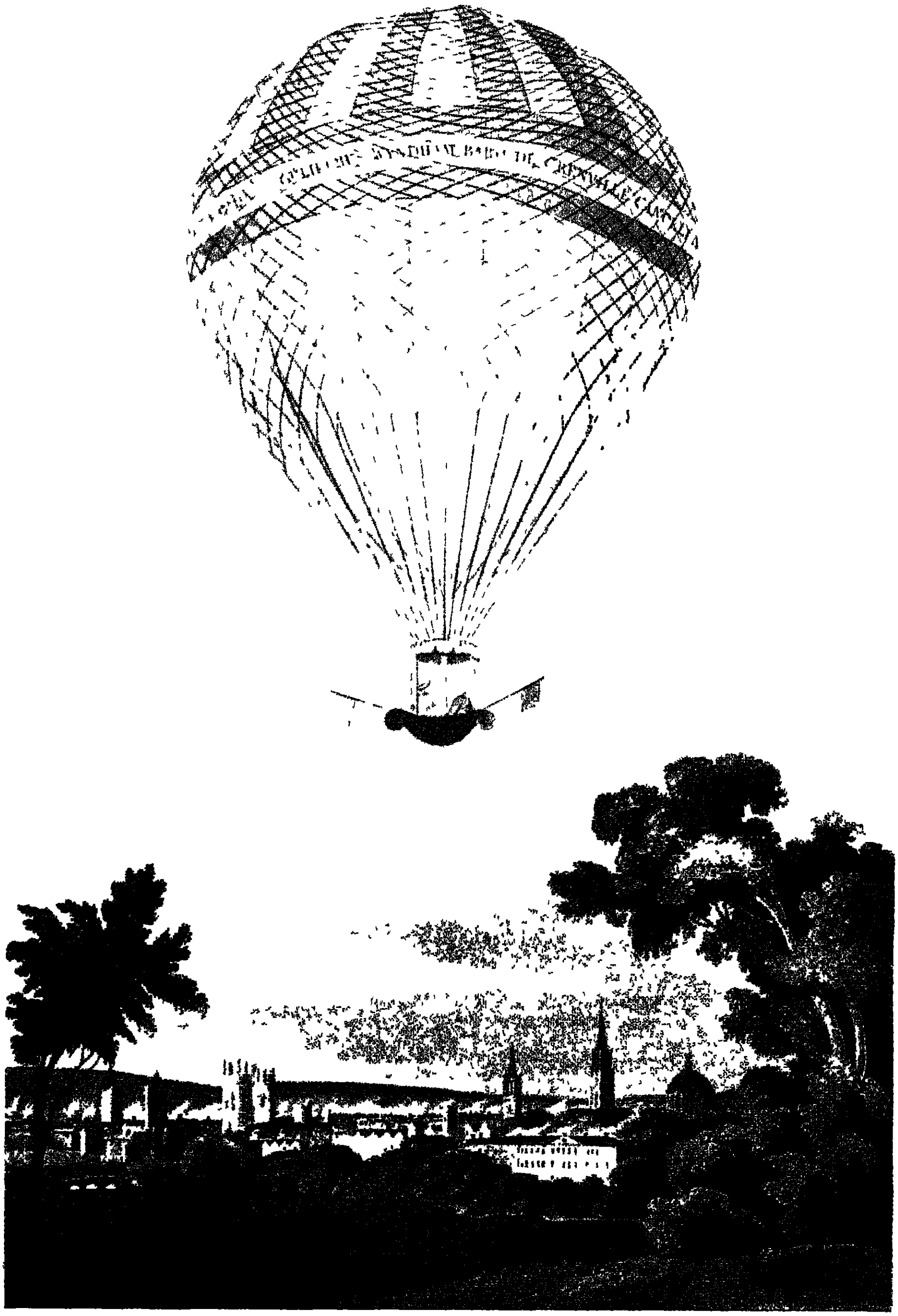


Fig 35 JAMES SADLER'S ASCENT FROM MERTON FIELDS, OXFORD
July 7, 1810

His Ascent at Oxford, July 7, 1810

During the next twenty-four years Sadler appears to have given up ballooning, but re-started his aeronautical career with new vigour about 1810.[1] On July 7th of that year he made an ascent from Merton Fields, Oxford, on the occasion of the installation of Lord Grenville, who, with Sir Sidney Smith and others, formed part of the distinguished company present. An immense crowd of people thronged the vicinity; ladies in gay attire assembled on the terrace of Corpus Christi, while the roof of the college, the steeple of Christ Church, and the tower of Magdalen, afforded points of vantage to witness the ascent. The balloon was said to be 'altogether the most magnificent ever exhibited in this country', and contained nearly 1,900 yards of varnished silk in gores of variegated colours, a band round the circumference bearing the words: 'Right Hon. Wm. Wyndham Grenville, Baro: de Wotton, Cancel. Univer. Oxon.' (Fig. 35). It measured 36 feet in diameter with a 'solid capacity' of 24,429 cubic feet, and took nearly four hours to inflate. Sadler, who was accompanied by his son Windham, took up with him several instruments for scientific observation, including two barometers, a Fahrenheit thermometer, a dipping-needle, an electrometer, and bottles for containing air from high altitudes. A parachute with a kitten in the basket also formed part of the equipment. From notes kept by the younger Sadler—who thus commenced his aeronautical career at the early age of fourteen—the balloon rose shortly before 2 p.m., a good landing being effected at 4.30 p.m. in a field at North Crawley in Buckinghamshire, much to the dismay, and even terror, of the neighbouring villagers.

Bristol, Sept. 24, 1810.

A more perilous voyage was that of September 24th, when he made an ascent—reported to be his sixteenth—from a field in the neighbourhood of Stoke's Croft, Bristol, accompanied by William Clayfield, 'a man distinguished for his chemical knowledge'. Passing over Redcliffe—where a parachute, with a cat suspended in a basket, was again successfully released—and Woodspring, near Clevedon, the balloon was driven across the Bristol Channel

[1] In this interval he was probably occupied with engineering work, for there is no reason to doubt he was the 'James Sadler of Oxford' who in 1791 took out a patent (No. 1812) for an improved steam-engine. (See Partington (C. F.), *Account of the Steam Engine*, 1822, App., p. 9, and Stuart (R.), *Anecdotes of Steam Engines*, 1829, vol. 2, p. 423.) In 1796 he was living in Dublin, for William Windham Sadler, his son by a second marriage, was born there in that year. Subsequently he held an appointment under the Admiralty as 'Member of the Board of Naval Works and Inspector of Chemistry'. At least he is so described on hand-bills of later ascents (see Fig 41), though Mr W. G. Perrin, the Admiralty Librarian, informs the writer he never heard of any such post.

towards Cardiff. Fearing the Welsh coast would not be reached, more sand was released, whereupon the balloon rose so fast that it passed through the sand first thrown out. With the thermometer at 37 an expansive view was visible extending into Cornwall, and Welsh and Irish coasts bearing on the right, and behind the coast of Monmouth. At the end of nearly three hours in the air, owing to the proximity of the sea, Sadler had to throw out everything available—even the grappling-iron, part of the covering of the car, and (surely with especial reluctance) a barometer given to Sadler by Dr. Johnson, for which he is said to have been offered 200 guineas. But the loss of gas left the balloon with insufficient lift to clear the cliffs near Combe-Martin, and it fell with some violence into the sea about four miles from the coast. After drifting, fortunately in calm water, for fully an hour—the partially deflated balloon acting as a sail—Sadler and his companions were rescued from a dangerous predicament by a boat from Lynmouth, where they eventually landed and whence they returned to Bristol the following day.[1]

Cambridge, July 2, 1811.

Sadler's experiences the next year included an ascent from the Great Court of Trinity College, Cambridge, when he proposed to take with him his two daughters. Unfavourable weather induced him to abandon this intention, and he offered the vacant seat to any gentleman for 100 guineas—an offer which, on being accepted by a Lieutenant Paget, R.N., had also to be abandoned owing to insufficient lift in the balloon. Sadler therefore ascended alone and came down near Stanstead in Essex—about twenty-three miles distant—when another bad landing was made in a severe squall, Sadler himself being dragged in the car through hedges and over fields, and his balloon suffering considerable damage. An excursion which excited greater interest—mainly owing to the fact that there had been no ascent in London for some years—was that made from the gardens of the Mermaid Tavern, Hackney, on August 12th, this being Sadler's eighteenth venture (Fig. 36). The balloon was the same as that used at Cambridge, but the car was a new one, being appropriately decorated in resplendent style in honour of the occasion—the Prince Regent's birthday. Rising from the ground shortly before three, with about 130 lb. of ballast, the balloon was carried at an 'immense height' towards the Thames, passed over East India Docks (which looked to the aero-

Hackney, Aug. 12, 1811,

[1] See Lockwood Marsh (no. 71, and frontispiece) for reproductions of the fine coloured aquatints of Sadler's rescue, and of his ascent at Nottingham (p 156, *post*).

FIG. 36. JAMES SADLER'S ASCENT FROM HACKNEY, AUG. 12, 1811.

nauts like 'two large cisterns'), crossed and recrossed the river, and was brought down within 300 yards of Tilbury Fort, about 4 o'clock. The landing in a brisk gale was a rough one, the car frequently touching the ground and rebounding, in the course of which Lieutenant Paget (who accompanied Sadler) was thrown out, but retained a hold on the rim of the car until the balloon had been secured by the help of some reapers. A second ascent from the Mermaid Tavern was made on August 29th, Sadler being accompanied by Henry Beaufoy, a scientist, as 'observer'. After a journey of ninety minutes, during which the balloon covered 47 miles, an easy landing was effected at East Thorpe, near Colchester.[1] Later in the year he effected a record flight in respect of rapidity of travel—that from Vauxhall, near Birmingham, on October 7th, when, accompanied by a gentleman named Burcham of East Dereham, Sadler's balloon was carried a distance of 112 miles in eighty minutes. On attempting to land he was thrown out of the car, Burcham being carried another mile and a half, the envelope eventually becoming entangled in an ash-tree, with the result that it was torn 'into a thousand pieces'. Shortly afterwards Sadler and his passenger—both imagining that the other had been killed—met, to their mutual delight, in the village of Heckington, near Spalding in Lincolnshire, not far from the points at which they respectively landed.

and Aug. 29th.

Birmingham, Oct. 7, 1811.

Perhaps Sadler's most ambitious exploit in the year following was his endeavour to cross the Irish Sea from Dublin to Holyhead—a feat which had been unsuccessfully attempted by Potain in June 1785.[2] The balloon used on this occasion was previously exhibited in Mosley Street, Manchester, at the end of May, had a diameter of 55 feet, and a capacity of 87,114 cubic feet, 4,119 lb. of 'cast iron turnings' being used with a commensurate quantity of vitriol to inflate two-thirds of the envelope. The ascent was made from Belvedere House at Drumcondra, the Duchess of Richmond and Lady Mary Lennox each presenting the aeronaut with a flag, the balloon rising from the ground, amidst the cheers of a vast concourse of people, shortly after half past twelve (Fig. 37). Though Sadler carried 11 cwt. of ballast, the ascent was a rapid one,

Attempt from Dublin, Oct. 1, 1812.

[1] A full account of this ascent as recorded by Beaufoy is printed in Forster's *Annals*, pp. 62–8 The Birmingham ascent on Oct. 7 is also there described, the rapidity being described as 'astonishing', and exceeding that of 'the racehorse Flying Childers'. A medal was struck at Birmingham to commemorate this event, bearing on one side the car of the balloon (21st ascent) and on the reverse a profile portrait of the 'First English Aeronaut' (Fig. 31).

[2] See *post*, p. 177.

and at the outset he was involved in a dangerous predicament owing to a rent in the balloon at the joining of the tube through which the valve-cord passed. Unable to repair the rent from the car, he resourcefully cut the rope used for the grappling-iron so as to form a temporary ladder, and by this means succeeded in tying a 'neck-cloth' in order to prevent any escape of gas. Carried across the Irish Sea towards the south-east coast of the Isle of Man, the balloon was soon after driven back by a contrary current, and at 4 o'clock—with the wind now blowing almost due west—was over Anglesea, at an altitude which Sadler recorded as '3 miles, 652 yards'. A further shifting of the wind to the south, or a varying current driving him off the coast, he valved gas at 5.30, and came down on to the water in the hope of being observed by passing ships. Fearing he had not been seen, he re-ascended, and in so doing he again saw the sun which had previously set below the horizon.[1] Descending finally into the sea he was dragged through the water, hanging to the car hoop, for nearly half an hour, and was much exhausted when he was picked up about forty miles north of Great Orme's Head by a herring-boat—the bowsprit of which, at Sadler's direction, was run into the balloon—and carried into Liverpool early next morning. An *Authentic Narrative* of the voyage (taken from the aeronaut's memoranda and corrected by himself), with sundry 'Observations on the important objects connected with Aerostation', was published later 'for the benefit of Mr. Sadler'. An apology is offered in the 'Observations' for the slow developments of the art, with the remark that 'not 50 years have elapsed since the genius of Black first conceived the idea of applying to Aerial Ascent' the gas which Cavendish had discovered. But although the writer claimed that Aerostation is connected with pneumatics, meteorology, magnetism, chemistry, and electricity, it cannot be said he adduces anything achieved in the way of scientific observations or improvements in practical ballooning to support the claim that 'much therefore has been done'.

William Windham Sadler (1796–1824).

During the next five years Sadler was assisted in his vocation as a professional aeronaut by his son William Windham Sadler, who made several 'solo' ascents.[2] The latter was brought up as

[1] Charles in his ascent in the first hydrogen balloon, on Dec. 1, 1783, witnessed the same phenomenon after Robert had landed from the car at Nesle.

[2] The exploits of James Sadler are frequently, not to say usually, confused with those of his two sons. Indeed, several writers on aeronautical history, e. g. Tissandier, Grand-Carteret, &c., appear to be unaware that there was more than one Sadler.

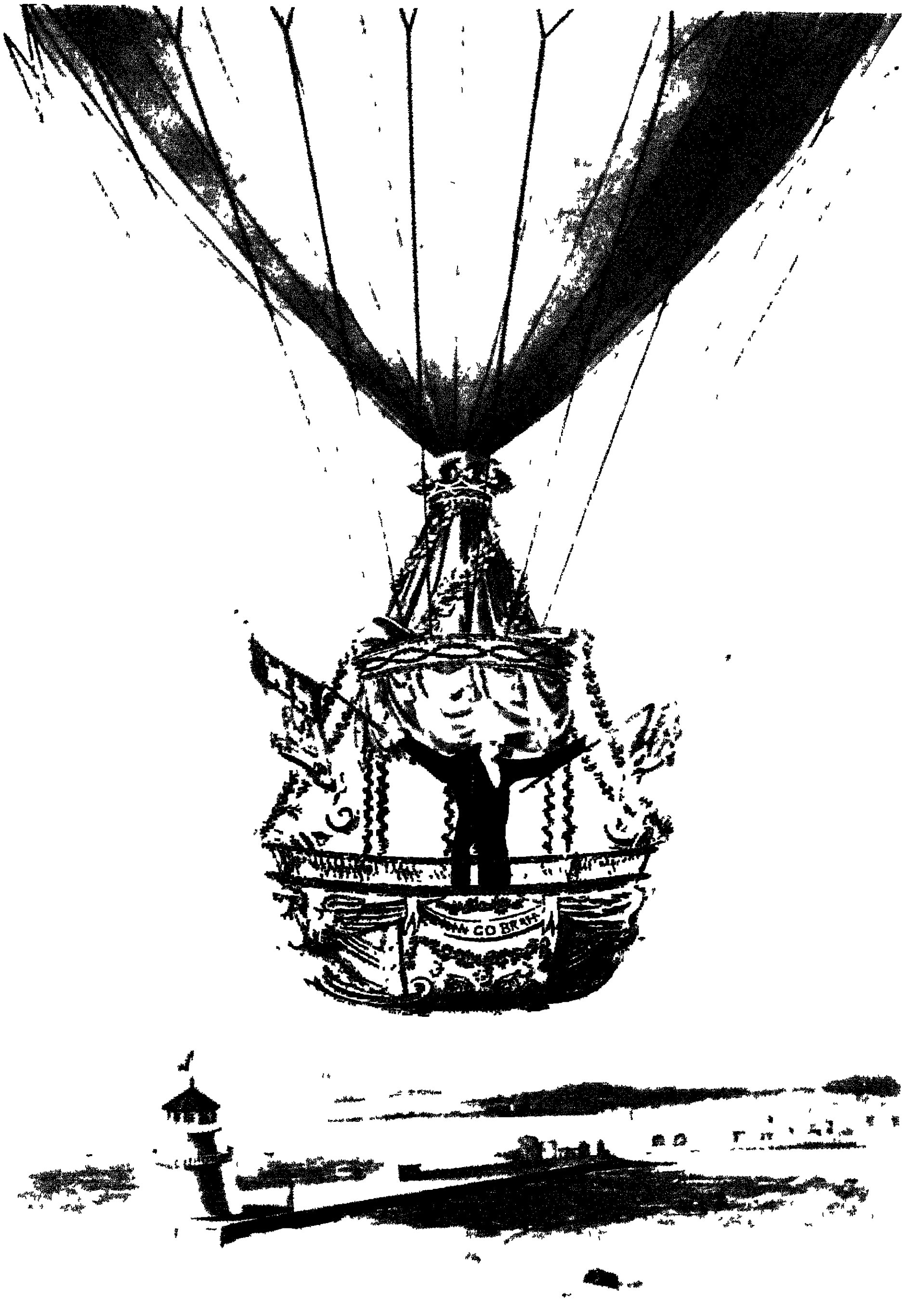


Fig 37 JAMES SADLER'S ASCENT FROM DUBLIN
Oct 1, 1812

an engineer, and in his studies acquired a good practical knowledge of chemistry, which must have been useful not only at this time but also—a few years later—on his entering the service of the Liverpool Gas Company. At the age of seventeen he made a 'solo' ascent—under his father's auspices—at Cheltenham, during which he encountered a severe snowstorm at a considerable altitude, a circumstance which he reported made it extremely difficult to open the valve, though after a short flight of an hour's duration a safe landing was effected near Chadlington Bridge, not far from Chipping Norton.[1] In May 1814 it was announced he had gone to Portsmouth to make arrangements for a voyage across the Channel to France, but apparently the idea was subsequently abandoned. Towards the end of the month he ascended with his father from the court-yard of Burlington House in honour of the Duke of Wellington, when, after having attained an estimated altitude of five miles—during which they suffered severely from cold and pain in the ears—a perfect landing was effected near Ockenden in Essex.[2] It was on this occasion James Sadler claimed that by making use of varying currents at different heights he could go wherever he wanted to—an achievement he wisely refrained from attempting to demonstrate too positively. Windham Sadler ascended again from the same spot on July 29th (Fig. 40), accompanied this time by a Miss Thompson, a young lady 'renowned in the Dramatic Corps', and after a flight of about three-quarters of an hour descended forty-five miles away, near Coggeshall.

Windham Sadler at Cheltenham, Sept. 7, 1813

Ascent with his Father from Burlington House, May 27, 1814.

Second Ascent from Burlington House, July 29, 1814.

An elder son, John Sadler, doubtless took part during these later years in his father's exploits and ascended with him, but apparently his own most notable was also his last ascent[3]—that made from St. James's Park on August 1, 1814, during 'the grand jubilee' held as a joint celebration of the premature peace, of the centenary of the accession of the Brunswick family to the throne of England, and (more laudably) the anniversary of Nelson's great victory of the Nile. It was announced that a Mrs. H. Johnstone

John Sadler's Ascent from St James's Park, Aug. 1, 1814.

[1] The ascent took place from a yard belonging to the Iron Railway Company on the Gloucester road. Despite an 'incalculable concourse' of spectators, very few paid for admission, whereby the elder Sadler lost a considerable sum.

[2] There is a letter in the Patent Office Collection, in the hand of the elder Sadler, respecting the attendance of an adequate force of police As a matter of fact the mob broke into the court-yard, from which (the affair being 'intended as a spectacle, not a massacre') no attempt was made to eject them.

[3] An autograph note in the Cuthbert Collection, signed 'John Sadler, 22nd Jany 1838', is the authority for this statement (Fig 38). Cf. Tissandier, vol. ii, p 22, whose error

would go up with Sadler, but on its being found 'that the fastening intended to secure the network to the valve at the top of the balloon was not sufficiently strong', it is said the Duke of Wellington advised that the ascent should be given up. However, 'the young aeronaut'—in the manner of his father—was not to be deterred, with the result that when over Woolwich he found the envelope had burst through the broken netting, and it was with difficulty that he avoided a catastrophe. On descending after about forty minutes near Mucking Marshes (sixteen miles below Gravesend), he promptly cut the envelope with his knife, which resulted in a safe though rather precipitate landing.

Windham Sadler's Ascents in the Provinces, 1814–16.

Windham Sadler gave other exhibitions during the latter part of 1814—amongst them one at York, another at Pontefract (during the race week, when he again ascended with Miss Thompson), and at Exeter, the latter recorded as his seventh ascent. On November 26th he narrowly escaped disaster at Plymouth, where in a strong wind the balloon became unmanageable just before the ascent, and on Sadler being obliged to get out of the car it broke away and was found later in a damaged condition near Tavistock. On June 29, 1815, he made an ascent from Norwich (he was at one time in danger of suffering a similar experience to that of Major Money), and on November 7th from Edinburgh—the first of its kind since the days of Lunardi—when owing to his having left his chart behind he valved gas after being in the air no more than eight minutes, and landed near Portobello.[1] Having adopted the career of a professional aeronaut, his reputation was greatly enhanced three years later by the successful crossing of the Irish Sea, a feat which he was the first to achieve on July 22, 1817. He ascended from Portobello Barracks at about 1.30 p.m., in a wicker-work car covered with glazed leather, the inflation, in which Windham had the assistance of his 'venerable father', having occupied nearly four hours. It was the aeronaut's intention to keep as low as possible so as to save time and gas, and he records that on being carried in a light wind at west-south-west, he took care to hold the balloon in the favourable current of air, by making frequent use of the 'counteracting Powers of Gas and

Windham Sadler crosses the Irish Sea, July 22, 1817.

is excusable as contemporary accounts simply refer to 'Mr. Sadler'. See also *Account of the National Jubilee*, 18 pp., 1814, in the Patent Office Collection, vol iii, fo 141.

[1] See Forster's *Annals*, pp. 71 and 86, where it is said that 'Sadler Junr.' made his 'second ascent' from Edinburgh on Nov. 4, 1815.

Fig. 38 John Sadler's Ascent from St James's Park, Aug 1 1814

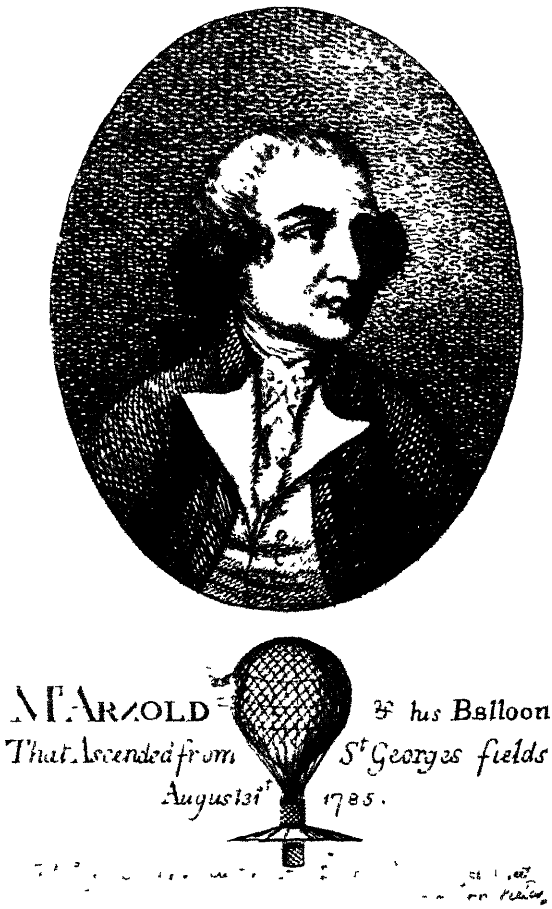


Fig. 39 STUART AMOS ARNOLD, and his Balloon, Aug 1785

Ballast '.[1] The balloon cleared the Irish coast near Howth lighthouse at 2.45, and twenty minutes later Sadler first caught sight of the Welsh coast-line. From the fact that an egg which he dropped from the car took twenty-nine seconds before it splashed into the water he judged his elevation at this point was not great, and as he shortly after passed over the land south of Holyhead lighthouse, he felt entitled to claim in his journal that he 'had been enabled so to regulate [the] Balloon, as to preserve a given altitude to pursue a direct line '. Opening the valve Sadler descended gently and touched ground at 7.5, ' the first Aeronaut ', as he is justly careful to note, ' who had successfully accomplished the passage of the Irish Channel '. Next day he returned to Dublin.

As his father had done in 1812 so the son also published a *Narrative* of the voyage, with additional remarks on aerostation in general. The question of the ' practical utility ' of balloons is raised in the sense of asking, whether they merely afford experiments for ' profit or amusement ', or are capable of higher and more important objects. It is pointed out that in England, ' the seat of Science and Literature ', aerostation had been left to individuals unaided in any other way than through the medium of exhibitions, and that until James Sadler began his career the public had ' remained satisfied with gazing on the casual experiments of *Foreign Aeronauts*, without a *single Native* turning his attention to the subject, although a Cavendish first discovered, and a Black first suggested—the application of the powerful agent, Hydrogen Gas, to the purposes of Aerostation '. While it is suggested that the science may be made use of as a mode of expeditious travel, for communication in war, and for atmospheric experiments, it is also realized that to render it ' practically useful for the purposes of life ', it is obvious that some means must be achieved to render the balloon ' obedient to the guidance of the Aeronaut '. But Windham Sadler's claim that his own success had ' been productive of much improvement to the Science of Aerostation ', cannot be easily substantiated.[2]

The exhibitions of the Sadlers from 1814 onwards are not

[1] Sadler's words hardly justify the statement in the *D. N. B.*, vol. l, p. 112, that he ' managed to keep the balloon (in a proper current) across the St. George's Channel '.

[2] Windham Sadler's *Narrative*, 1817—printed, as in the case of his father's attempt, by W. H. Tyrrell of Dublin—was also sold ' for the benefit of Mr. Sadler '. It contained the same chart, with the addition of the course taken by Windham's balloon.

always distinguishable, as the aeronaut was usually styled in the advertisements and elsewhere 'Mr. Sadler'. Occasionally 'Sadler junr.' is specified, but seeing that the father was at this time over sixty years of age, it is probable that most of the ascents after 1815 were undertaken by Windham Sadler. It was, however, the elder Sadler who made the first balloon excursion from Nottingham on November 1, 1813, when he travelled thirty-three miles in fifty-nine minutes and landed at Pickworth in Rutlandshire.

Jas. Sadler's Balloon for Louis XVIII, 1814

During the early part of 1814 he spent considerable time in constructing a balloon at the express desire of Louis XVIII for use at his coronation at Rheims, though force of circumstances diverted the original purpose, with the result that Sadler had to alter the decorative work designed as appropriate to France into the national trophies of his own country. He first used this balloon and its 'superbly elegant' car for the flight from Burlington House in May 1814, and again for his forty-seventh ascent made from Newcastle-on-Tyne on September 1, 1815. On this occasion special attention was called (by means of descriptive handbills) to the splendour of the car, while the balloon itself was said to present, when inflated, the appearance of 'a magnificent Temple', 75 feet in diameter and 'capable of lifting 72 Persons'.

His Ascent from Cork, Sept. 1816. Windham Sadler (with Livingstone) at Liverpool, Sept. 28, 1819. York, Sept. 1823

Presumably he also used it for the uneventful ascent he made from Cork in September 1816.[1] On the other hand it was doubtless Windham who accompanied Livingstone in his ascent from Liverpool on September 28, 1819, from which city he also made a solo ascent on another occasion.[2] In September 1823 he went up from near Micklegate Bar, York, in stormy weather, and at the outset narrowly escaped disaster from being dashed against the Bar wall, in which situation 'he dexterously secured himself in the basket by the cords, and thus escaped'.

Attempts at Sheffield to use Coal Gas, Sept. 1823.

Early in the same month he made two attempts at Sheffield which, though unsuccessful, are of interest, in that the failure was attributed to some extent to the 'density of the coal gas' with which the balloon was inflated. It is usually accepted that Charles Green was the first (on the occasion of his ascent from the Green Park on July 19, 1821) to use coal gas with success, but seeing Windham Sadler was for some

[1] The ascent at Cork is recorded by MacSweeny (p. 25). In the author's abrupt style it is dismissed in six words, but two sentences are devoted to the story of an Irishman who came from afar to witness the event, fell asleep after drinking whisky, and only awoke when it was all over. 'This liquid', the author adds in a laconic and inconsequent comment, 'has often spoiled the finest prospects of many an Irishman.'

[2] See note at end of Ch. X

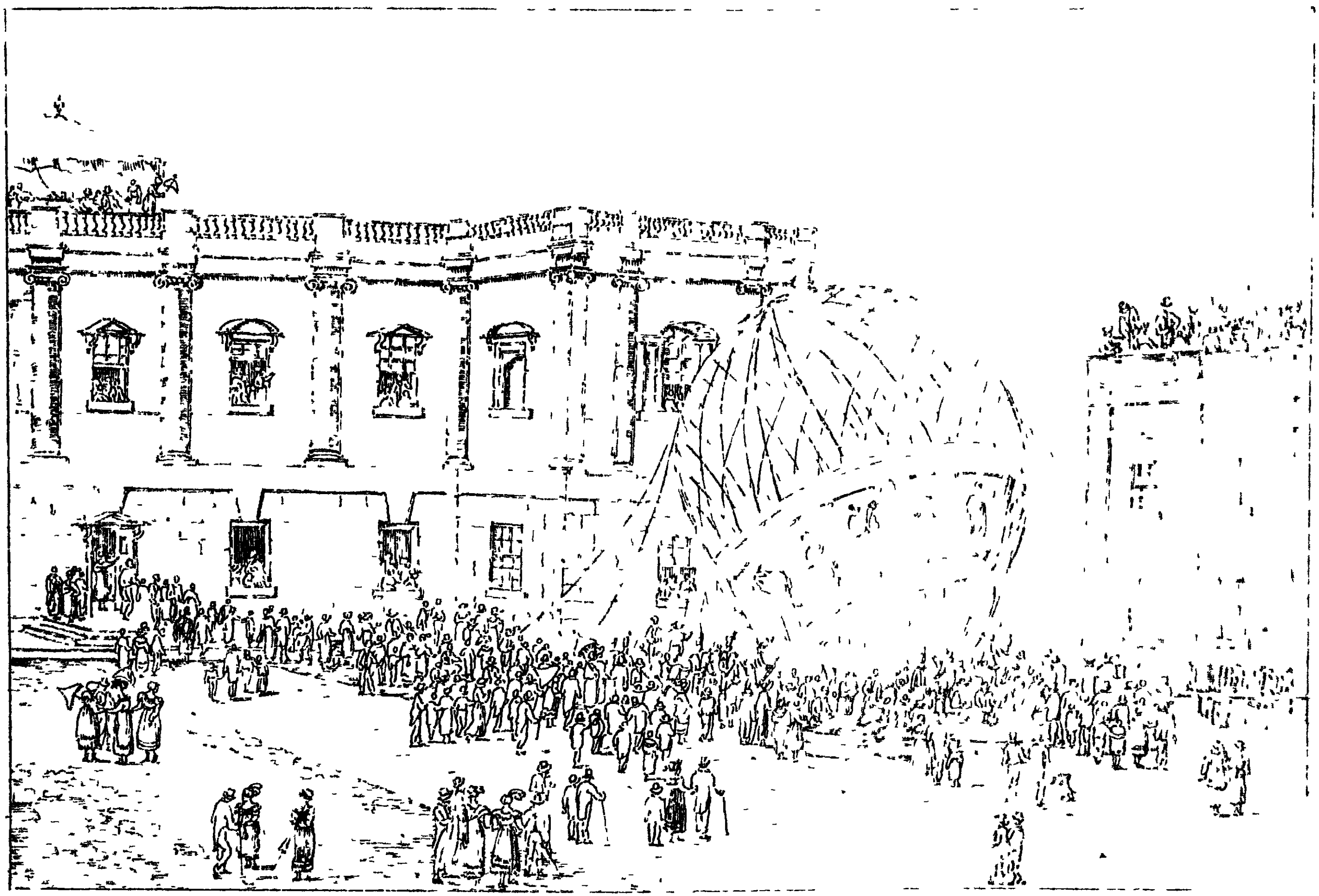
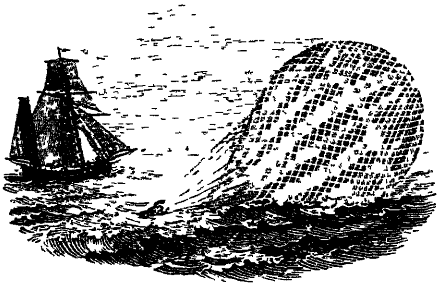


Fig. 40 WINDHAM SADLER'S ASCENT FROM BURLINGTON HOUSE, JULY 29, 1814

years associated with the Liverpool Gas Company, it is a little remarkable that the idea of doing so did not occur to him earlier. In this connexion it may be added that Windham Sadler knew something of Green, for the latter assisted at an ascent made by Sadler from Leeds during 1823.

Grand Balloon.

DESCENT of Mr. SADLER
in the Irish Channel,
after passing over 237 Miles
by Water, and 43 by Land.



MR. SADLER,

Late Member of the Board of Naval Works, and Inspector of Chemistry to the Admiralty,

Friday the 1st of September WILL make his 47th ASCENSION, from Newcastle, on ~~Tuesday the 29th of August~~, 1815, at Three o'Clock precisely. The *grand Balloon* which ascended from *Burlington-House* at the *National Jubilee*, and *superb Car*, is now exhibiting at Mr. Ball's Long Room, Turk's Head, Bigg-Market, Newcastle, and will be exhibited every Day, from ten in the Morning till Dark, until the Day of Ascension.—Admittance one Shilling.

Description of the Balloon and Car.

The Car is superbly elegant, and originally intended to have ascended from France, at the Coronation of Louis XVIII and is fitted up in a particularly splendid Manner for the Occasion Its Shape Oval, supported at either End by Eagles, apparently rising from the Shell of the Nautilus, which is modelled and finished in a most masterly Style, it is lined with Purple Embossed Velvet, finished with Purple and Gold, the upper Pannel, a Mosaic Railing, terminating with the Arms of England,, so disposed, as to form the Elbow of the Car, and on either Side hangs Pendant the Badges and Stars, of the Orders of St Andrew, and St Patrick, in Gold Embroidery, encircled with Wreaths of Oak in Relief This splendid Vehicle is attached by Ropes of burnished Gold, which appear as if supporting the Base of the Canopy, round which are painted the twelve Signs of the Zodiac, relieved with Clusters of Silver Stars; the Canopy is formed of Purple Silk, intersected with Spiral Lines of Oak, in which the Rose and Thistle are entwined, these Lines are held by Eagles standing on the Edge of the Base, and between each of the Eagles are the Prince's Plumes, in Or, the Drapery Purple and Yellow, richly embroidered, and trimmed with Gold Fringe and Tassels, the whole surmounted with a rich Coronet, and forming one of the most splendid and elegant Vehicles that Fancy can picture

S. Hodgson, Printer, Newcastle

FIG. 41.

Death of Windham Sadler at Blackburn Sept. 29, 1824.

Windham Sadler met his death near Blackburn when making his thirty-first ascent on September 29, 1824. The balloon of 27,800 cubic feet capacity was inflated with coal gas at the gas works in Bolton, and ascended at 2 o'clock with Sadler and his servant, James Donnelly, the weather—high wind, rain, and a dense and cloudy atmosphere—being very unfavourable.[1] Rising almost immediately to a considerable height, Sadler decided after about a quarter of an hour to descend, owing to the misty conditions. According to eye-witnesses the balloon fell with great rapidity near Foxhill Bank, between Blackburn and Haslingden, but public knowledge of balloons was then so vague that it is not easy to reconstruct the tragedy which ensued. It is clear that the grappling iron, which was as usual thrown out, broke, doubtless owing to the violence of the wind, and the balloon was driven against the chimney of a house, throwing Sadler out of the car, from which, however, he remained suspended by his legs in mid-air. A few moments later he fell to the ground, and the balloon with the helpless servant —aghast at the fate which had just overtaken his master—was carried some three miles farther, before Donelly was able to make a hazardous landing, in which he escaped with considerable injuries.[2] Sadler was unconscious when those near by came up to him, and after lingering a few hours he died early the following morning. His body was subsequently removed to Liverpool, where he was well known and greatly esteemed, and buried in Christ Church.[3]

Death of Jas. Sadler. Mar 26, 1828

The elder Sadler outlived his son and died at Oxford on March 26, 1828. He was buried in the churchyard of St. Peter-in-the-East, where his tomb-stone, though defaced by age, still stands erect— the sole monument to a neglected though worthy son of the ancient city.[4] For though Sadler was a man of humble origin, with no academic connexion and lacking in any scientific knowledge, he

[1] See *The Courier* of Oct. 4, 1824. The balloon is said to have been constructed on a 'superior scale', being 42 feet high by 34 feet in diameter, composed of 534 square yards of silk in alternate gores of crimson and yellow.

[2] The balloon was subsequently reported by the captain of a Revenue cutter—sailing in a strong gale off Flamborough Head—to have fallen into the sea.

[3] See *Gentleman's Mag.*, 1824, vol ii, p. 366, and *D. N. B.*, vol. l, p. 113. Cf. Forster, pp. 89–90, and Tissandier, vol. ii, p. 29, where the accident is described as happening to 'l'aéronaute anglais Sadler'.

[4] *Jackson's Oxford Journal*, Mar. 29, 1828. In the *Oxford University Herald* of the same date the death of 'Mr. James Sadler, elder brother of Mr. Sadler of Rose Hill', is briefly recorded, without any reference to his ballooning exploits.

applied himself with diligence and enthusiasm to a wholly novel invention, the elements of which he had to learn by experience. To judge from such meagre information as is available he appears to have been a sturdy, honest man, one who inspired confidence, and who was endowed with a full measure of courage, the latter quality calling forth from Erasmus Darwin the well-deserved title of 'intrepid'. If it cannot be claimed that either Sadler or his sons, Windham and John, made any notable contributions to the science of aerostation, they are justly entitled, nevertheless, to a place of honour in the early annals of ballooning in England.

MELANCHOLY
Death of Mr. Sadler,
By a Fall from his Balloon.

A Letter was last night received by the Editor of the Morning Chronicle, from Blackburn, near Manchester, dated Thursday. Sept 30, announcing the death of Mr Sadler, who made his thirty first ascension from Bolton, the day previous, accompanied by his servant man

The balloon was seen hovering over Church Parish, about four miles east of Blackburn, about half-past three o'clock, when the voyagers prepared to descend, and threw out a grappling-iron, which caught a tree, and the sudden jerk threw Mr. Sadler out of the car, and broke the cord. The balloon then dragged the car, to which Mr. Sadler was suspended by the leg The car struck a chimney, and knocked it completely down, and shortly after Mr. Sadler fell to the ground from the height of about thirty yards, into a meadow! Crowds of persons immediately assembled, and conveyed him to a publichouse

Several medical gentlemen proceeded to the spot, and rendered their aid, but without effect, for they found Mr. Sadler's skull much fractured, and a considerable portion depressed upon the brain; he was insensible and had several ribs broken and had sustained serious internal injury. He lingered until eight o'clock this morning, when death put a period to his sufferings. The balloon, lightened of Mr. Sadler's weight, rose rapidly to a considerable height, and again descended near Whalley, about three miles from the place of the accident, and the car coming in contact with some rails the the man jumped out, and had his left arm fractured and received other injury Mr. Hardy set his arm, and rendered other medical assistance, and the man then set off in a post chaise to Bolton The balloon lightened of both the adventurous aerounauts, rose rapidly into the air, and has not since been heard of

A Coroner's Jury is about to be summoned.

To add to this melancholy event, the landlord (Mr. Blenkinsop) of the public-house where Mr. Sadler's body lies, was returning from Accrington, and, when within a few yards of his house, he dropped down in an apoplectic fit, and immediately expired.

Birt, Printer, No. 33, Great St Andrews-Street, Seven Dials

FIG. 42.

CHAPTER VII

EARLY FOREIGN BALLOONISTS IN ENGLAND: BLANCHARD, ZAMBECCARI, ETC.

It can hardly be denied that the development of the balloon in England during the early years of the invention owed not a little to the presence of enthusiastic foreign pioneers. Two of the earliest French pioneers, Pilâtre de Rozier, a young scientist of recognized ability and the world's first aeronaut, and J.-P. Blanchard, the first of professional pilots, paid visits to this country during 1784–5, while two Italians, Count Francesco Zambeccari and Vincent Lunardi, had been active—as already related—at an earlier date. Moreover, Faujas de Saint-Fond, an eminent French scientist and one of the earliest authoritative writers on aerostation, during a journey through England in the autumn of 1784 (mainly for purposes of geological exploration) made inquiries of Priestley and others on the chemistry of aerostation, which doubtless tended to stimulate a reciprocal interest among English scientists. Further, Faujas was accompanied on this journey to Scotland by Paolo Andreani, who had been the first to make a balloon ascent in Italy—at Milan on February 25, 1784.[1]

Pilâtre de Rozier in England, 1785.

The visit of Pilâtre de Rozier to London (during which he was accorded the honour of being voted a member of the 'Balloon Club') was probably connected with aeronautical matters. Though not known to have made any ascent in England, he was certainly present on the occasion of Blanchard's ascents in London during May 1785, and Major Money, on returning from Colchester after the voyage in Lockwood's balloon on June 3rd, met him when dining with Lord Orford at Epping. Incidentally it may be mentioned that Pilâtre had recently become engaged to an English girl, Miss Susan Dyer, to whom—according to Erasmus Darwin—he had promised to give up the dangerous pursuit of ballooning. The story of his tragic death a fortnight later—near Boulogne on

[1] See Faujas de Saint-Fond (B.), *Journey through England, &c., in 1784*, Glasgow, 1907. Also Boffito, p. 219.

June 15, 1784—is well known, and was rendered the more distressing in that Miss Dyer was an eyewitness of the fatal disaster.[1]

Blanchard's connexion with aerostation in England was of a more active kind and of longer duration, and his exploits deserve a fuller relation. Jean-Pierre Blanchard was born at Les Andelys on the Seine, in 1753. Though of humble origin and little education, he was gifted with a lively imagination and an inventive mind, which he applied in youth to the study of mechanics. At an early age he took up the idea of mechanical flight, and having made careful observations on the flight of birds, he eventually conceived and constructed a 'vaisseau-volant' designed on the 'ornithopter' principle. An account of this machine was published in the *Journal de Paris* in August 1781, and a set of four coloured engravings—with textual explanations—was produced by Martinet about the same time.[2] Discouraged by lack of financial support Blanchard had thoughts in 1782 of leaving France, a course from which he was, however, dissuaded. His project becoming more widely known, he was visited by the Duc de Chartres, whose interest in such matters was shown later in the construction to his order of the first cylindrical balloon made by the brothers Robert, whom he accompanied on their first ascent on July 15, 1784. A public demonstration of Blanchard's machine was subsequently arranged, but the rain preventing any attempt the inventor had to satisfy himself and the assembled audience by reading a paper on the subject—a performance which must have proved much easier to accomplish, and in which he held out the assurance (according to the *Biographie Universelle*, 1851) that with his machine he could ascend in all places, at all times, and attain a speed in flight of seventy-five miles an hour. But his words could not be made good, and probably the boastful and vain promises had no other result than that of increasing the severity of the caricatures directed against his machine. On the invention of the balloon by the Montgolfiers, Blanchard's hopes of ultimate success were revived, and he was quick to seize on the newly discovered 'aerostatic' principle as a means of overcoming difficulties to which his mechanical attempts had succumbed.[3]

J.-P. Bl chard (1753–1809).

His 'Va seau Volant 1781.

[1] Darwin (E.), *The Botanic Garden*, 3rd edition, 1795 (Economy of Vegetation, Canto IV, line 150, &c.). The turgid lines in which Darwin describes the fate of Pilâtre must be one of the earliest poetical tributes to the first martyr in the cause of aerostation.

[2] The Cuthbert Collection includes a set of these coloured engravings. They are reproduced in Bruel, nos. 7–10. See also *I. L. A.*, nos. 377–80.

[3] See Tissandier, vol. 1, p. xxii, and Blanchard's letter to Montgolfier in Dupuis-Delcourt, p. 21.

By the early spring of 1784 he had constructed a hydrogen balloon, to the car of which he fitted wings and a rudder, while between the envelope and the car he introduced a parachute—such mechanism being presumably adapted from his 'vaisseau volant'. The suggestion that the original intention was to release the balloon at a certain height, and then effect a flight by means of the wings, the parachute being designed as a safeguard against 'crashing', is, however, of doubtful origin.[1]

His First Balloon Ascent at Paris, Mar. 2, 1784.

On February 27, 1784, a first attempt was announced, but was postponed until March 2nd, when the balloon was inflated on the Champ de Mars. The story of the attack on Blanchard by Dupont is well known, though how far the cadet's action resulted in the discarding of the wings and parachute, or how far Blanchard's ascent without them was perforce due to miscalculation in the 'lift' of the balloon, cannot definitely be known.[2] Certainly the boastful tendency which Blanchard still showed in premature announcements of his intention to descend at La Villette, received another severe blow, for an unkindly wind carried him in a directly contrary direction and he landed at Billancourt, near Sèvres.

Ascents at Rouen in May and July 1784.

After having made two successful ascents from Rouen on May 23rd and July 18th, but being still disappointed at the lack of public recognition—and probably jealous of the honours showered on Montgolfier and Pilâtre de Rozier—he came to England towards the end of August. An advertisement appeared in the press on September 1st, in which Blanchard announced his intention of making a 'Grand Aerostatic Experiment', during the course of which he engaged to perform various 'evolutions and manœuvres'. Presumably he brought a balloon over from France, for the same announcement states that the 'Globe and Flying Vessel' was on exhibition at Christie's Great Room in Pall Mall. If so it would seem that his connexion with Keegan's 'Montgolfière' balloon was merely incidental to his visit to London—Sheldon or Keegan may have invited his co-operation as an aeronaut of experience and repute—for Blanchard is not known to have made any public reference to the affair, which was certainly unlikely to enhance his fame, or attract subscribers to his own projects.[3]

His First Ascent in England, Oct. 16, 1784.

Blanchard's first ascent in England was that made from Little Chelsea, on October 16, 1784, when he was accompanied by Dr. John Sheldon, a distinguished anatomist, of which science he

[1] See Ch. XIV for an account of Blanchard's experiments with parachutes.

[2] Cf. Tissandier, vol. 1, p. 62, and Lecornu, p. 88.

[3] See *ante*, Ch. IV, p. 114.

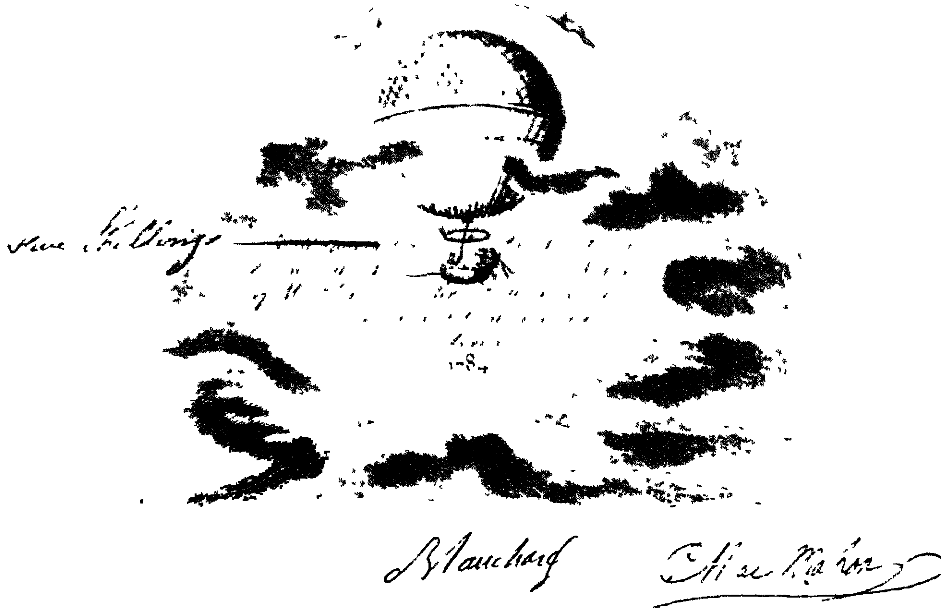
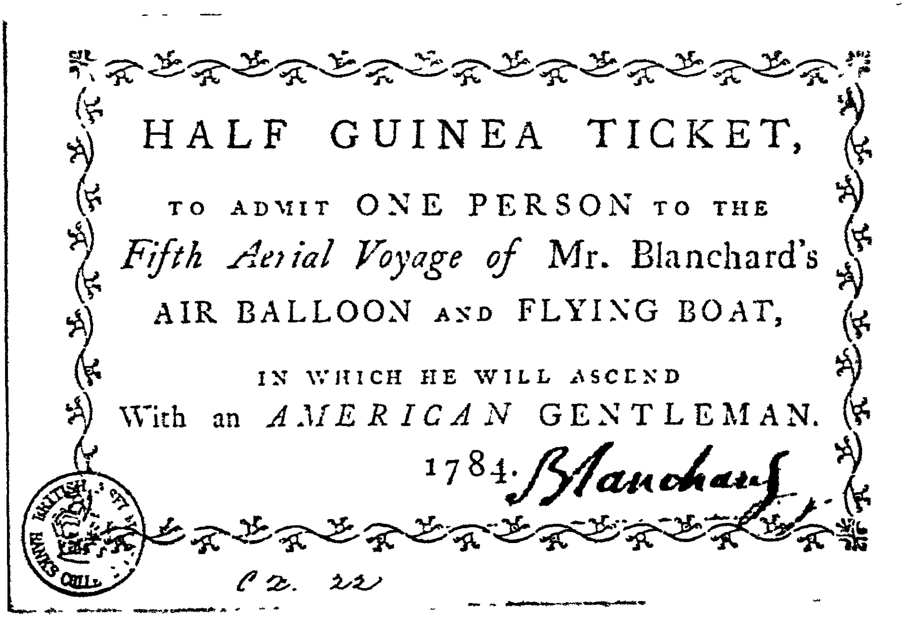


FIG 43 Signed Admission Ticket for Blanchard's Ascent from Chelsea Oct 16, 1784


HALF GUINEA TICKET,

TO ADMIT ONE PERSON TO THE

Fifth Aerial Voyage of Mr. Blanchard's

AIR BALLOON AND FLYING BOAT,

IN WHICH HE WILL ASCEND

With an *AMERICAN* GENTLEMAN.

1784. Blanchard

C 2. 22

FIG 44 Signed Ticket for Blanchard's Ascent with Dr Jeffries, Nov 30, 1784

was then professor to the Royal Academy. Though the claim—that of being the first Englishman to ascend in a balloon—which is usually made for Sheldon by reason of this aerial voyage with Blanchard, cannot be maintained in view of Sadler's ascent on October 12th, it must be allowed that he was the first Englishman to make a 'voyage' in a balloon, and one of the first with scientific attainments to take an active interest in aerostation.[1] As previously recorded he followed Lunardi on horseback on the occasion of the famous ascent on September 15th, and it has been seen that he was associated with Blanchard in the matter of Keegan's English Balloon.

The ascent from Lochée's Military Academy on October 16th attracted so great a crowd that, owing to the confined nature of the approaches, many people of great distinction were unable to arrive in time, while considerable damage was done to the neighbouring gardens. The inflation of the balloon—the upper half of green silk and the lower of light yellow—was carried out under the direction of Aimé Argand, assisted by William Parsons, 'the Comedian,' and thirty workmen.[2] Instead of being elevated on a platform as at Lunardi's ascent on September 15th, the envelope was suspended between two perpendicular poles—a method previously adopted in France—and the gas was admitted by means of two appendices, with the result that the operation was completed in an hour and a half, as against twelve hours in the case of Lunardi's first ascent. Having liberated two small pilot balloons (the first carrying a dog suspended in a small car), Blanchard and his scientific companion—from whose observations something more was expected (to quote the words of a contemporary account clearly directed against Lunardi)

[1] See *ante*, Ch. IV. Cf. also [Wadd (Dr. W.)] *Epitaphian Mementos (in Stonecutters' Verse)*, &c., 1827, p. 44, where it is stated that Sheldon was a great patron of aeronauts, and boasted of being the first Englishman who had made an experimental ascent.' In the epitaph it is said of him that in leaving 'a grave profession', and

> Adventuring in an air-balloon,
> To *raise* a great renown,
> Science and Art did grieve to think
> How much he *let it down*.

[2] Cavallo (p. 326) was informed by Blanchard that he joined the segments of the envelope by overlaying the edges of the varnished silk half an inch, and then passing a hot iron over them. To render the seams more secure they were stitched with silk thread and covered with a riband. (Cf. note on p. 247 *post*). The varnish used by Blanchard consisted of elastic gum dissolved in five times its weight of spirits of turpentine, 1 oz. of which he boiled in 8 oz. of drying linseed oil.

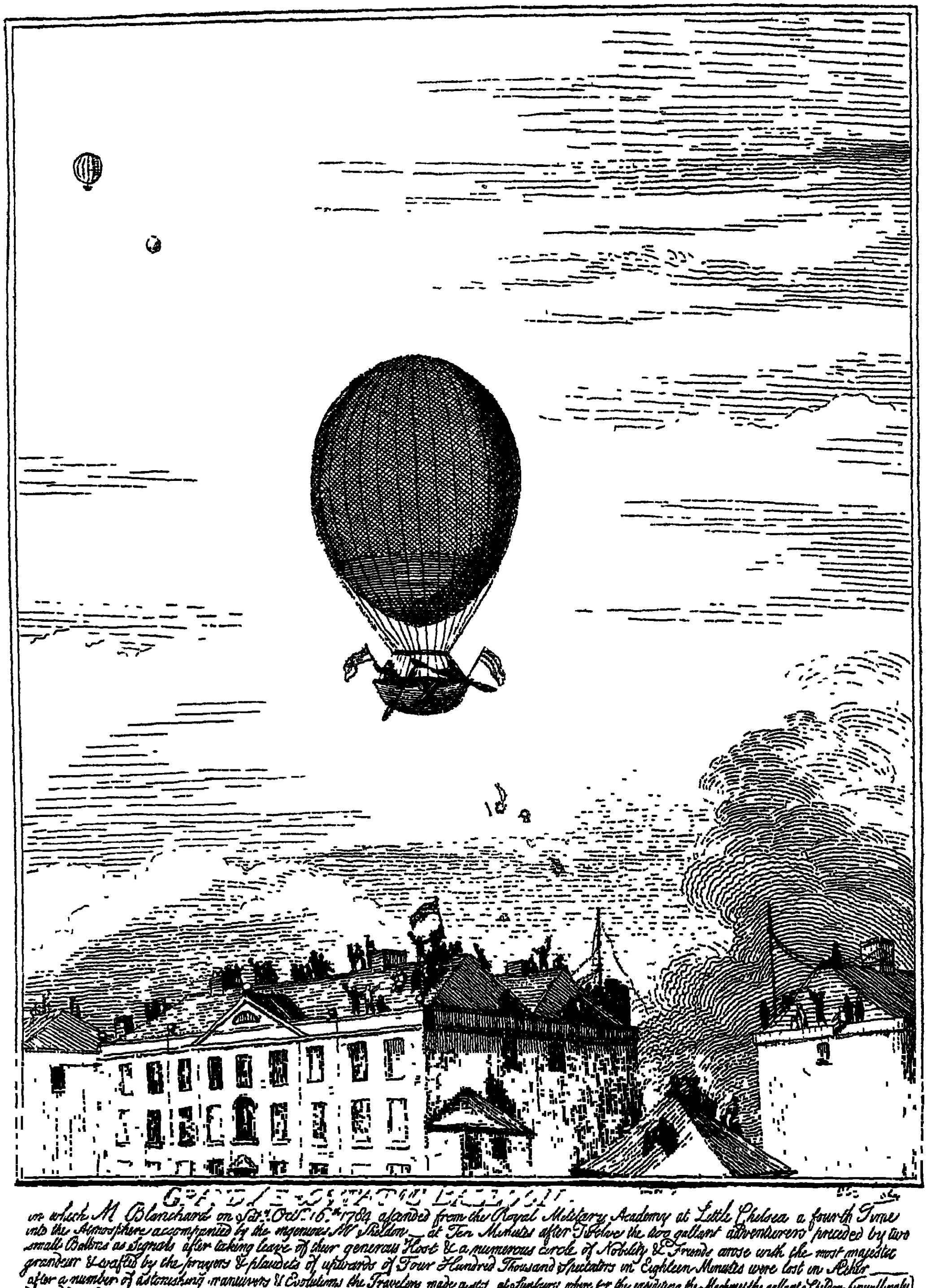

on which M Blanchard on Satʸ Octʳ 16ᵗʰ 1784 ascended from the Royal Military Academy at Little Chelsea a fourth Time
into the Atmosphere accompanied by the ingenious Mʳ Sheldon — at Ten Minutes after Twelve the two gallant adventurers preceded by two
small Balloons as Signals after taking leave of their generous Host & a numerous circle of Nobility & Friends arose with the most majestic
grandeur & wafted by the prayers & plaudits of upwards of Four Hundred Thousand Spectators in Eighteen Minutes were lost in Æther —
after a number of astonishing manœuvres & Evolutions the Travelers made a step at Sunbury where for the expediting the Machine the gallant Sheldon (unwillingly)
descended & left his friend to pursue alone his Journey through the trackless void who after passing over Guildford Farnham &c about 3 o clock in the afternoon finding
the day too far spent to cross the Channel to Brest after hovering a considerable Time over Portsmouth the Isle of Wight &c &c alighted at Rumsey near Southampton and
amidst universal acclamations finished by far the most extraordinary Journey ever performed by a sublunary being —

Fig. 45.

than 'a collection of catchpenny quackeries about guardians, cats, feelings, and glass-bottles'—seated themselves in the boat-shaped gondola shortly before 12 p.m. Their ballast consisted of sand, and they carried a considerable outfit of scientific instruments, as well as food, a basket of pigeons, and the aeronaut's pet lap-dog. Moreover, the car was fitted with the wings which, despite Blanchard's exaggerated claims, had proved a failure in France, and it is not surprising that on being let go the heavily weighted balloon rose from the ground very slowly, amidst the acclamations of the spectators. Alighting in a garden close by, ballast and other things had to be thrown out, an incident which was said at the time to have been caused by some pique on the part of Blanchard who wished to ascend alone.[1]

Having cleared the neighbouring buildings, a north-westerly breeze carried the balloon, with both aeronauts waving flags, over Hammersmith, Chiswick, and Twickenham, from which point the descent was gradual, until a landing was made near the seat of Lord Vere at Sunbury. Here Sheldon alighted, and Blanchard having taken in further ballast to within 20 lb. of his companion's weight reascended alone. The balloon rose much more rapidly than before, and those few horsemen who, with a number of ladies, had set out from Chelsea to 'hunt' the balloon, and who had overtaken the chase at Sunbury, now quickly lost sight of their quarry behind the clouds. Having attained in the space of four minutes to a greater height than on the occasion of his ascent from the Champ de Mars, Blanchard opened the valve and came down through the fog, but at 'thirty-eight minutes past one'—the apparent precision is characteristic of the aeronaut's circumstantial method of narration—being anxious to see how much gas he had lost, he shut the tubes by holding them in his hands. Subsequently he released more ballast and the balloon (with doubly increased lift owing to the heat of the sun's rays) rose rapidly to so great a height that he experienced great difficulty in breathing. He records that at this point he made no use of his 'fly', but allowed himself to be carried 'at the mercy of the winds', a situation which led to observations on the uselessness of the compass when out of sight of the earth. About two o'clock the cold was so severe

[1] Another more ingenious explanation was that the atmosphere being 'exceedingly encompassed', was 'rarified with the breaths of surrounding thousands', thus 'rendering the air less buoyant'

that Blanchard was again obliged to valve gas, passing at a lower altitude over Chertsey—George III had a 'tolerable view' of the balloon from the Observatory at Windsor—and later over Farnham, by which time he had again descended so low that he was able to see the people in the grounds of the Bishop's Palace waving their handkerchiefs, in acknowledgement of which he threw down one of a number of specially printed cards, on which he scribbled a few words of thanks. A little later, after passing between Alton and Sherborne and immediately over the City of Winchester, Blanchard relates one of the many picturesque, but highly improbable incidents which adorn his journals. Having inadvertently dropped his colours, he determined to recover them by opening the valve, and in watching the flag as it fell, he allowed the gas to escape so freely that the balloon came down with sufficient velocity to damage the gondola on striking the ground—a 'disaster' for which Blanchard records he was fully compensated by the pleasure of seizing the flag in the air as he descended.[1] Rebounding from the shock and having thrown out ballast to 'restore the equilibrium', he decided to descend in view of his apparent nearness to the sea, and an easy landing was affected by the aid of a 'single tree in the midst of an open field' near Romsey, seventy-three miles from London. The neighbouring villagers having taken hold of the ropes, the balloon, with Blanchard—who was unable to speak English—still in the car, was walked through the streets of the town amidst throngs of excited spectators. The next day Blanchard—now joined by Sheldon, who had followed him on horseback—returned to London, taking with them the balloon, and the 'aerial travellers' received a triumphant reception when, a day later, they arrived at the place of departure at Chelsea.[2]

The success of the ascent from Chelsea led apparently to some rivalry with Lunardi, and a few days later it was reported that the latter had been challenged by Blanchard to engage in a balloon race of three heats—with the wind, across the wind, and (this last a discreetly qualified condition) whoever 'loses least against the wind'. Though nothing came of the suggestion Blanchard was able to announce early in November that he was engaged in com-

[1] The views of the late Air-Commodore E. M. Maitland and M. Chas. Dollfus (both experienced balloon pilots) as to this incident, greatly differ—the former regarded it as most improbable, to the latter it appears quite feasible. It may be added that M Dollfus, whose authority on aeronautical history the writer esteems highly, holds a more favourable view of Blanchard's character than that expressed in these pages.

[2] Blanchard (J -P), *Journal of the Fourth Voyage of Mr. Blanchard, with John Sheldon*, 1784.

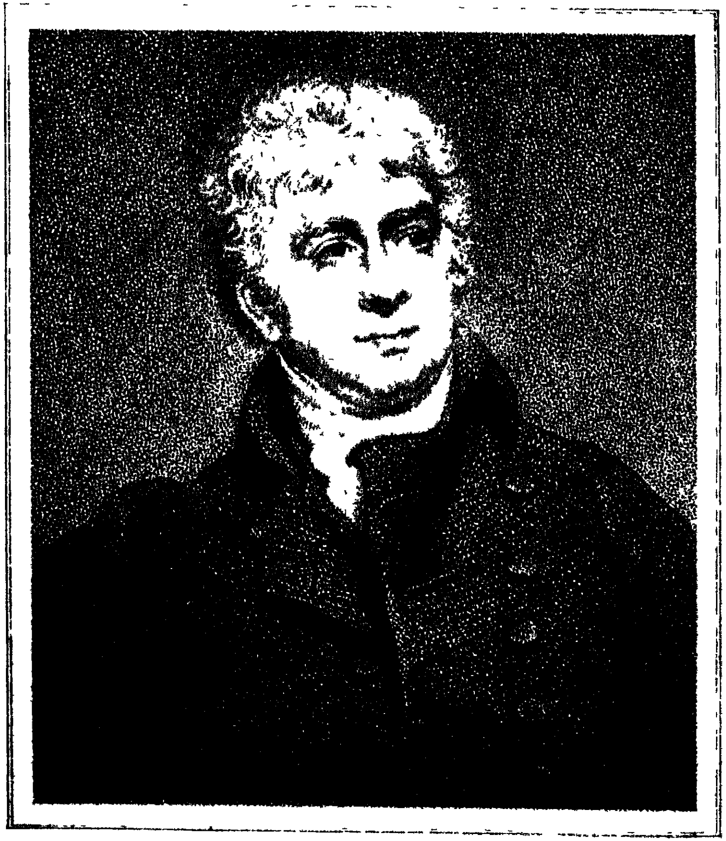


FIG 46 JOHN SHELDON
Who Ascended with Blanchard on Oct 16, 1784

FIG. 47 JOHN JEFFRIES
In the Car of Blanchard's Balloon on the Cross-Channel Voyage, Jan. 7, 1785

pleting arrangements at Dover for a Channel crossing, and that prior to undertaking it he would ascend with 'an American gentleman', Dr. Jeffries, from Mackenzie's Rhedarium, near Grosvenor Square.[1]

Dr. J. Jeffries (1744–1819).

John Jeffries, born in Boston in 1744, first came over to England in 1768, and having taken his medical degree returned home the next year. Coming over again in 1779 he worked with the famous surgeon, John Hunter, and remaining in this country for about ten years—at the time of his ascents with Blanchard he was living in Cavendish Square, London—he gained a considerable reputation both in his own profession and as a scientist, meteorology being his special study.[2] As a man of considerable means he must have proved a useful patron to Blanchard—Jeffries himself records that he paid £100 for his seat in the car on November 30, and that the entire expense of the Channel voyage (amounting to the substantial sum of over £700) was borne by him.

Second Ascent in England, Nov. 30, 1784.

Though originally announced for November 29th, the second ascent—actually it was Blanchard's fifth aerial exploit—was deferred until the day following owing to the weather. It was made in the presence of the Prince of Wales and other distinguished personages, the Duchess of Devonshire holding one of the cords just before the balloon was released. The ascent was not at first successful, and the difficulty encountered at Chelsea of clearing the surrounding chimneys and trees, was again experienced. But Blanchard appears to have impressed his supporters with great aeronautical skill—he was compared with Lunardi (to the disadvantage of the latter) as the most expert aerial traveller, an exquisite mechanic, and the inventor of the only successful 'oars or wings'—for when on this occasion the balloon had drifted away in the gentle westerly wind, it was believed that by using his oars he had complete control of the machine. As a proof of this it was pointed out, quite erroneously but with complete assurance, that two small balloons released after Blanchard's ascent, having passed him, showed thereby that his balloon 'was not under the influence of the wind, but under that of Mr. Blanchard himself'. After a trip of about two hours a landing was made at Stone Marsh, near Ingress, a few miles beyond Dartford, in Kent.

[1] The Rhedarium was an enclosed space situated between Park Lane and Park Street.

[2] Dr Jeffries returned to Boston in 1789 and lived there until his death in 1819.

The First Channel Crossing, Jan. 7, 1785.

Undoubtedly Blanchard's most interesting and remarkable voyage was the crossing of the English Channel in company with Dr. Jeffries, on January 7, 1785. According to Jeffries, in his own *Narrative of the Voyage*, he not only took upon himself the prepartions for it, but also furnished all the materials and labour for the inflation. Prior to the ascent some difficulties arose between Blanchard and his patron, owing apparently to Blanchard's contention that the balloon (it was the same in which he had made previous flights) would not on this voyage carry more than one. But having regard to Blanchard's boastful character—in which it seems there was also a strain of meanness—and bearing in mind the incident with Sheldon on October 16th, it may be that on this more important occasion Blanchard wished to reserve to himself alone the distinction of being the first to cross the Channel in the air.[1] Whatever the reason, it is on record that Jeffries felt so far aggrieved as to resolve on strong measures, and he presented himself before the gates of Dover Castle supported by a number of sailors—in the manner, it was suggested, of King Charles demanding the surrender of Hull—and sought admission with the idea of taking away the balloon. After some display of militant intentions on the part of Jeffries, and a more determined attitude of defence on the part of the garrison, Jeffries withdrew, the differences being subsequently settled by agreement (through the intervention of the Governor of the Castle) and the first voyage finally arranged.[2]

The Ascent from Dover.

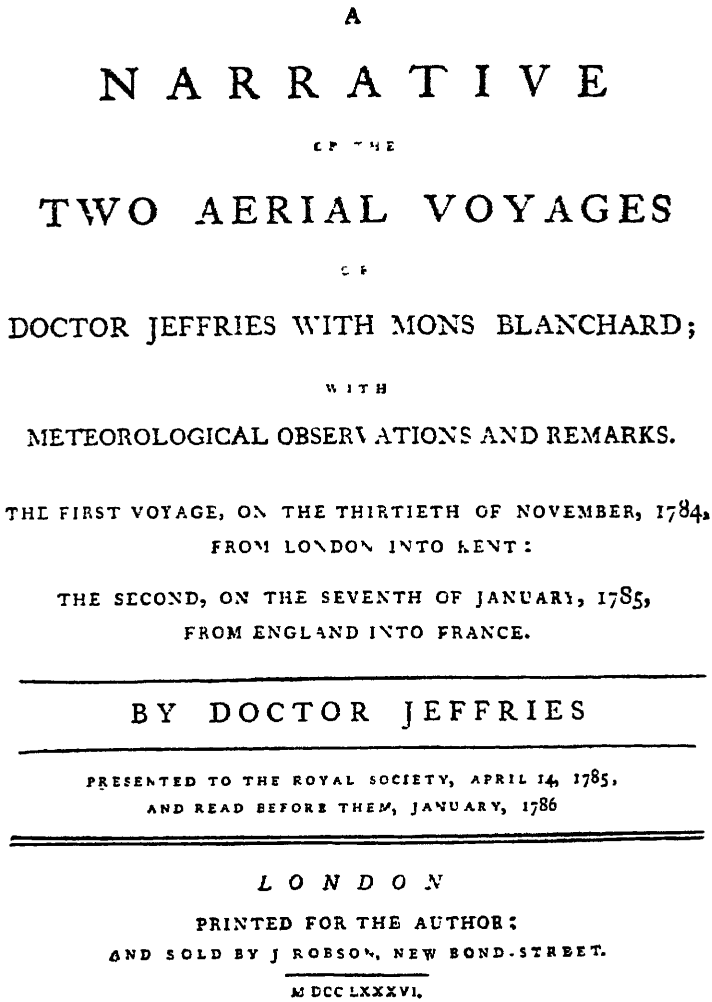
The inflation having been successfully accomplished by Blanchard, with the help of James Deeker (the balloon maker of Soho), the balloon rose gently over the edge of the high cliffs soon after 1 p.m., the wind (which was very light) bearing NNW. In the sea below the fisher-folk from the port were sailing and rowing about, their craft filled with large numbers of sightseers bent on beholding this unique adventure, for hitherto no aeronaut had set out on a flight over the water.[3] At the outset—owing partly, perhaps,

[1] Jeffries (Doctor), *Narrative of Two Aerial Voyages with M. Blanchard*, 1786, Second Voyage, p. 40 (misprinted 04). Amongst other devices by which Blanchard tried to deceive Jeffries was that of secretly increasing his weight by wearing a leaden girdle.

[2] Tissandier states the original idea was that Lunardi should accompany Blanchard and Jeffries, but this suggestion being found impracticable, Lunardi crossed to France to await them.

[3] Fig 49 As a matter of fact Pilâtre de Rozier had for some months been preparing to cross from the other side, but his efforts were frustrated until June 15, 1785, when his attempt in a combined hot-air and hydrogen gas balloon resulted in the death of Pilâtre and his companion, P. A Romain.

to the 'cargo' they carried in the form of the oars and the 'fly' used in the former voyage, letters to the French nobility enclosed in an inflated bladder, a compass and other instruments, a bottle of brandy, a copy of the French edition of Blanchard's *Voyage with*



A

NARRATIVE

OF THE

TWO AERIAL VOYAGES

OF

DOCTOR JEFFRIES WITH MONS BLANCHARD;

WITH

METEOROLOGICAL OBSERVATIONS AND REMARKS.

THE FIRST VOYAGE, ON THE THIRTIETH OF NOVEMBER, 1784,
FROM LONDON INTO KENT:

THE SECOND, ON THE SEVENTH OF JANUARY, 1785,
FROM ENGLAND INTO FRANCE.

BY DOCTOR JEFFRIES

PRESENTED TO THE ROYAL SOCIETY, APRIL 14, 1785,
AND READ BEFORE THEM, JANUARY, 1786

LONDON

PRINTED FOR THE AUTHOR;
AND SOLD BY J ROBSON, NEW BOND-STREET.

M DCC LXXXVI.

Fig. 48.

Sheldon, two silk ensigns, and two cork jackets—Blanchard found it necessary to throw over a considerable amount of ballast, leaving only three sacks of 10 lb. each. The balloon now rose steadily, and Jeffries (in a letter to Sir Joseph Banks) subsequently described with rapture the expanding view—landward the towns and villages of the Kentish weald, and to seaward the outlines of the

French coast, with the Goodwin Sands between. When about midway across channel a downward run of the balloon resulted in the discharge of the remaining ballast, and thereafter Blanchard and his companion were reduced to throwing away everything in the car. The situation at this juncture of a famous aerial voyage is thus described by Jeffries.

'We had not now any thing left to cast away as ballast in future, excepting the wings, apparatus, and ornaments of the Car, with our cloaths, and a few little articles; but as a counterpart to such a situation, we here had a most enchanting and alluring view of the French coast, from Blackness to Cape Blanez to Calais, and on to Gravelines, &c.

'At about half past two I found we were again descending very rapidly, the lower pole of the Balloon next us having collapsed very much, so, that the Balloon did not appear to be three-fourths distended with gaz. We immediately threw out all the little things we had with us, such as biscuits, apples, &c., and after that one of our oars or wings; but still descending, we cast away the other wing, and then the governail; having likewise had the precaution, for fear of accidents, while the Balloon was filling, partly to loosen and make it go easy, I now succeeded in attempting to reach without the Car, and unscrewing the moulinet, with all its apparatus; I likewise cast that into the sea.—Notwithstanding all which, the Balloon not rising, we cut away all the lining and ornaments, both within, and on the outside of the Car, and in like manner threw them into the sea. . . . As we did not yet ascend, we were obliged, though very unwillingly, to throw away our anchors and cords; but still approaching the sea, we began to *strip ourselves*, and cast away our cloathing, M. Blanchard first throwing away his *extra coat*, with his surtout; after which I cast away my *only coat*; and then M. Blanchard his other coat and trowsers; We then put on and adjusted our cork-jackets, and prepared for the event. We appeared at this time to be about three-quarters of the distance towards the French shore, and we were now fallen so low, as to be beneath the plane of the French Cliffs. We were then preparing to get up into our slings, when I found the mercury in the Barometer again falling, and looking around, soon observed that we were rising, and that the pleasing view of France was enlarging and opening to us every moment, as we ascended, so as to overlook the high grounds. . . . We now ascended to a much greater height than at any former period of our Voyage, and exactly at three o'clock we passed over the high grounds between Cape Blanez and Blackness; thus forming in our ascending entrée a most magnificent arch; at which time, nothing can exceed the beautiful appearance of the villages, fields, roads, villas, &c., under us, after having been just two hours over the sea.' (Op. cit., p. 44 etc.)

Eventually the balloon descended in the forest of Guînes not far from Ardres, Jeffries stopping further progress by seizing hold

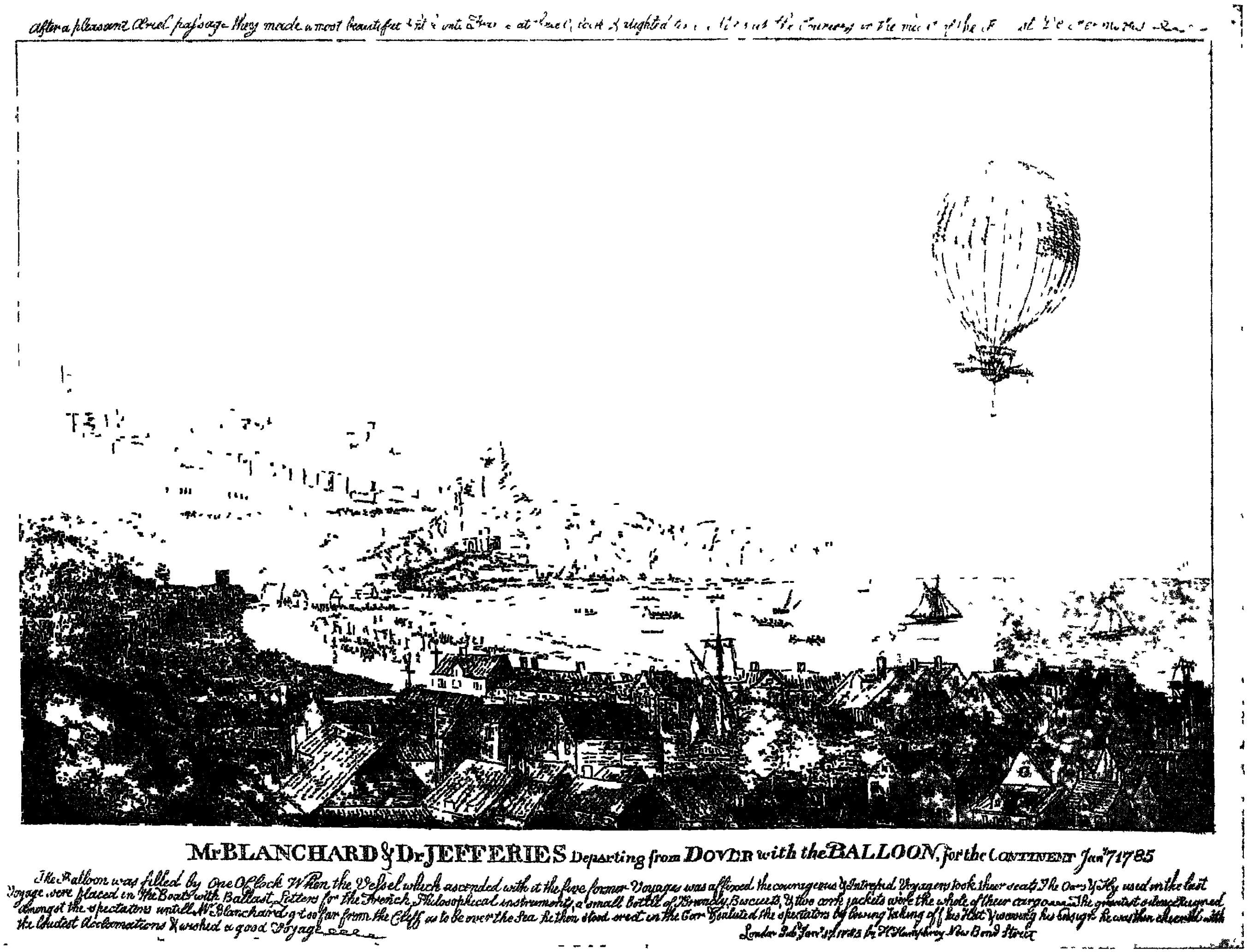


FIG 49 BLANCHARD AND JEFFRIES LEAVING DOVER, JAN 7, 1785
The First Channel Crossing in a Balloon.

of the branch of a tree.[1] Having deflated the balloon the two aeronauts were conducted to Calais, the gates of which—it being past midnight—were specially opened for their admission. Next day there followed public receptions and other marks of honourable distinction, Blanchard being subsequently awarded by his Sovereign a pension of fifty pounds.[2]

Ascents from Barbican, May 3 and 7, 1785.

Blanchard soon returned to England in furtherance of other aeronautical projects. Having finished what he called 'a Balloon and Gallery on a new construction', by means of which he proposed before ascending to 'attempt some evolutions in the air' (20 or 30 feet from the ground), Blanchard advertised that his fourth experiment in England would take place from Langhorn's Depository in Barbican. A novel feature was announced in the statement that, for the first time in England, a lady would ascend in the car. Though reported to have been at first frightened, Miss Simonet, a young French girl, and (according to Horace Walpole) the 'daughter of a dancer', enjoyed this distinction on a very still day, and Blanchard was able to impress the public with the fact that he landed in 'the very spot from which he first set out', having been 'towed' thither by ropes—a fact discreetly passed over in the claim subsequently made that this feat showed he was 'no vain pretender to the noble science of Aerostation'. He renewed the ascent from Barbican four days later, on which occasion he landed at Hornchurch in Essex.

His Aerostatic Academy.

The popular success of Blanchard's ascents, encouraged (it should be added) by a free use of advertisements of the 'showman' type, doubtless afforded hopes that his undertakings might prove profitable as commercial ventures. With a view to taking full advantage of the ballooning vogue, he opened in the Stockwell Road, Vauxhall, a place to which he gave the grandiose name of the 'Balloon and Parachute Aerostatic Academy'. Early in May he announced that he would ascend from his 'Academy', which was some four acres in extent and suitably enclosed 'with high walls' all round, for the purpose of trying 'several experiments of Hawks flying after their game'. On the 21st of the month

[1] Jeffries records that they had to adopt one last and 'curious' expedient to lighten the balloon before landing. His opinion that, left to itself, a balloon 'would always describe a single arch, with but very little horizontal progress' from ascent to descent, reveals an advance in the empirical knowledge of ballooning at this date (*Narrative*, op. cit., p. 50).

[2] A monument was erected on the spot where the landing was made, and the car of the balloon is preserved in the Museum of Calais. See engraving in the *Narrative*.

(with the assistance of Pilâtre de Rozier) he made another flight accompanied by a younger Miss Simonet, on which occasion, after landing near Deptford, the balloon was 'walked' back by means of ropes to Vauxhall.[1]

Parachute Experiments, June 1785

On June 3rd Blanchard undertook his first parachute experiment in England.[2] On this occasion having ascended in his balloon to a considerable height, he released a silk parachute beneath which was suspended a cat. Blanchard himself landed on the north side of the river opposite Woolwich, when he was greeted with a salute from the guns, and subsequently invited by the artillery officers to dine at their mess. The parachute experiment was so far successful that Blanchard announced he would repeat it by experimenting on a sheep, but the attempt made on June 16th was a failure, and in order to alleviate an angry show of disappointment Blanchard had to return the spectators their tickets. Possibly this affair marked the end of the short-lived Aerostatic Academy, and in any case the attraction and the novelty of Blanchard's exploits were doubtless beginning to wane. Owing to financial difficulties he must have given up the place before the end of June, for he left England shortly afterwards to try his luck in further aerostatic ventures on the Continent.

His Later Career

On July 12, 1785, he made an ascent from the Oude Hof at The Hague, and landed near Gouda, while on July 30th he went up from Rotterdam.[3] Blanchard returned to England once again in 1788, but his second sojourn was of much shorter duration, and thereafter his career as an aeronaut passes outside the scope of this record. He continued to make ascents—notably at Lille on August 26, 1785 (where in company with the Chevalier de L'Espinard he travelled 300 miles); from Frankfort-on-the-Main on October 3rd of the same year (this being the first balloon ascent made by any aeronaut in Germany); and a series of ascents from Nancy, Strassburg, and Nuremberg in 1787. In 1793 he paid a visit to the United States, where he was the first to achieve an aerial voyage, made from Philadelphia January 9, 1793.[4] Returning in 1798, he made

[1] The writer heard the expression 'walk' used in modern aerostatic navigation, during the housing (at Pulham Airship Station) of the first of the 'North-Sea' type of non-rigid airships in April 1917.

[2] See *post*, Ch. XIV, p. 322.

[3] See Fuld (E.), *Uit de Eerste Jaren der Luchtvaart in Nederland*, 1918, p. 33.

[4] Blanchard (J.-P.), *Journal of my Forty-fifth Ascension, being the first performed in America, Jan. 9, 1793*, 4to, 1795. Cf. Wise, p. 249, and Jackson (J.) *The First Balloon Hoax* (reprinted from *The Pennsylvania Mag. of History, &c.*, Jan. 1911).

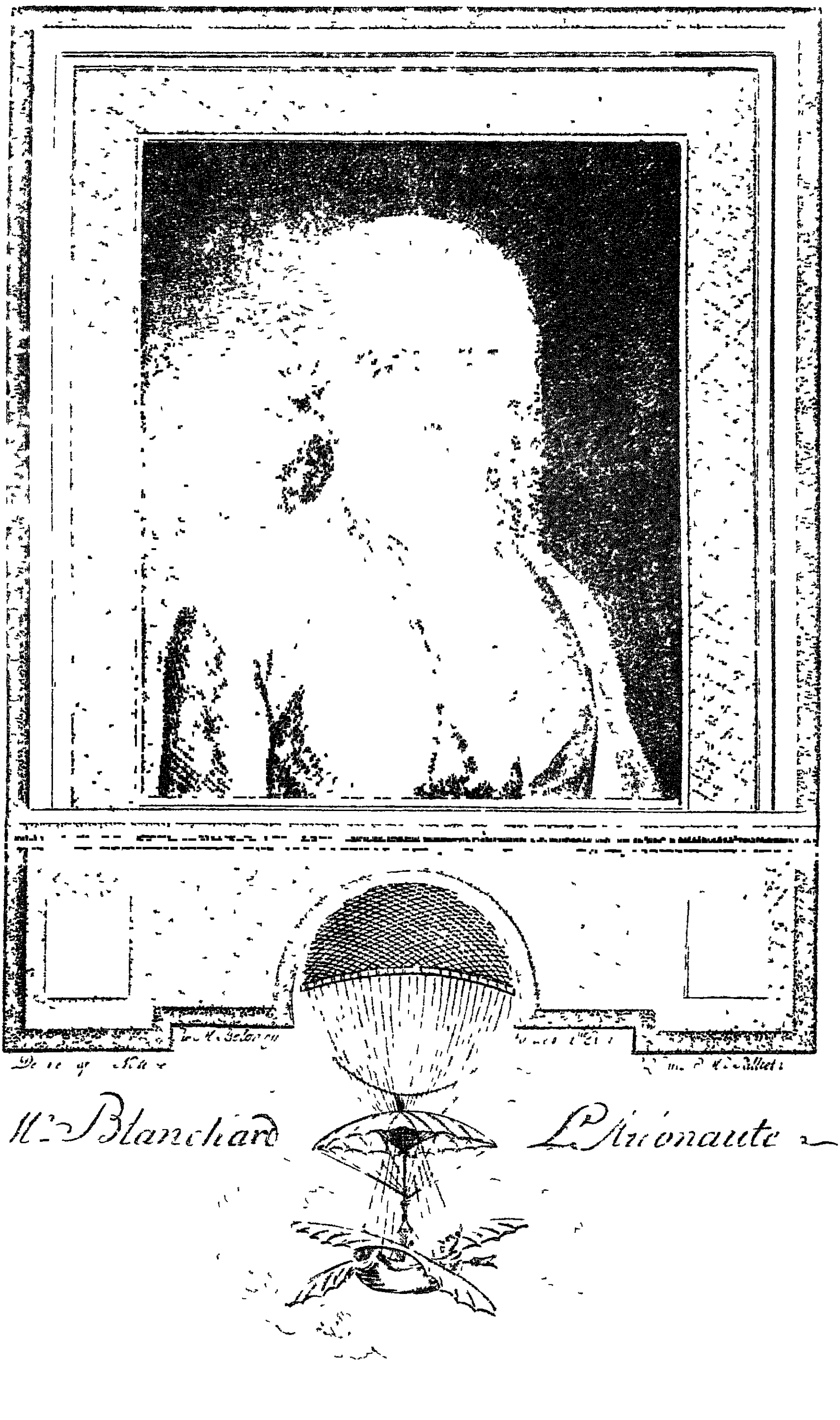


FIG 50 JEAN-PIERRE BLANCHARD.

further ascents at Paris on July 26, 1799 (accompanied by the scientist Lalande), Nantes in 1800, and from Rouen, Lyons, and elsewhere in 1805. His last ascent was from The Hague—it is recorded to have been his sixtieth venture—in February 1808, and on this occasion he made use of a 'Montgolfière' balloon. Seized with an apoplectic fit in mid-air he was thrown heavily to the ground, and though subsequently able to travel back to France, Blanchard never really recovered. He died in Paris on March 7, 1809.[1]

and Death, Mar. 7, 1809.

Blanchard was a man of small physique (his weight on the occasion of his ascent from Barbican was given as exactly 114 lb.) with an active, energetic, and courageous temperament.[2] Though his mechanical aptitude doubtless stood him in good stead in the course of his aerostatic career, and enabled him to acquire considerable technical skill in the art of piloting the balloon, his lack of scientific knowledge debarred him from making any notable contribution to the science of aerostation. Moreover, his boastful assurance savoured too much of the showman, and indeed his career must be regarded as in the main that of a professional aeronaut, ballooning being for him primarily a matter of pecuniary gain. But his numerous and on the whole successful exploits in the air give him a prominent place among the pioneers of aerostation at large, and (by reason of his early exploits in England) not least in the ballooning records of this country.

Blanchard's Character.

The early experimental balloon ascents in England undertaken by another pioneer of foreign birth, Count Francesco Zambeccari—who was destined to lose his life under tragic circumstances in the cause of aerostation—have already been described. Encouraged by the success of his experiment at the Artillery Ground in November 1783, he records that diverting his studies from the subject of fortifications to that of aerial globes, he commenced the construction of a balloon 30 feet in diameter, with the hope that it would prove capable of being guided at will. Subsequently he opened a subscription—for like his rival, Vincent Lunardi, he had no means of his own—but in this he was (as he himself said) 'unhappily disappointed, and afterwards supplanted in his Aero-

Count F. Zambeccari (1756–1812).

[1] *Biographie Universelle*, Nouvelle Édition, vol. iv, 1851, pp. 412–15. Coutil (L.), *Jean-Pierre Blanchard*, Évreux, 1911. Tissandier (vol. i, p. 130) relates, more dramatically, that Blanchard died in the car of his balloon, immediately after the ascent.

[2] The Patent Office Collection (vol. iii, fo. 59) includes a passport granted to Blanchard, with particulars of his features, height, &c.

static designs '.[1] Doubtless the official position Lunardi held as Secretary to the Neapolitan Embassy, coupled with his handsome looks and an attractive manner, gave him advantages which were denied to Zambeccari, who was in London merely as a refugee. However that may be the result was failure, and Zambeccari, with growing feelings of resentment against his successful rival (whom he regarded as having forestalled his own intentions), fled to Boulogne a ruined man. Returning to London he became reconciled to his father, who, though affording his son financial assistance, remonstrated against the insupportable expense ' of such a frivolous thing as a balloon '. Nevertheless Zambeccari worked hard to bring his endeavours to fruition, and in December 1784 he completed the construction of a balloon 34 feet in diameter, with a gondola (curiously contrived and richly ornamented) 11 feet long designed to carry three people. Zambeccari claimed that his machine—which he is careful to add was not intended for ' mercenary purposes '—had a ' striking superiority over every other construction of the kind exhibited in Great Britain ', and in the following January he announced his intention of ascending in company with ' a Gentleman of the first distinction ', and also—if such a daring creature were forthcoming—a lady.

His Ascent in London, Mar. 23, 1785.

After considerable delay, during which time the balloon was on exhibition at the Lyceum in the Strand, the ascent was fixed for March 23rd, on which date—a very cold day with sleet, snow, and rain—the inflation was effected in an enclosed space in the Tottenham Court Road. Admiral Sir Edward Vernon, a Miss Grist, and Count Zambeccari having got into the gondola, it was found that there was not sufficient ' lift ' to carry all three, whereupon the lady—whom Zambeccari a little ungraciously characterized as ' only an accidental passenger '—had to be ejected ' with gentle force ', owing to her reluctance to forego this novel experience (Fig. 52). As typical of the inexact knowledge of ballooning at this day, the count's own description of the flight may be quoted. Having referred to the incident with Miss Grist, he continues :

' I then took in three Sacks of Sand, weighing each 12-lbs, but as the Wind was violent, and it was apprehended the Balloon would not clear the Houses, I threw overboard two of the Sacks, in Consequence of which the Balloon, with my intrepid Companion, ascended very rapidly exactly at Three-

[1] See Boffito, ch. xv, where it is said that Lunardi's earlier success was regarded by Zambeccari with great contempt.

Fig 51 Signed Admission Ticket for Zambeccari s First Ascent, Tottenham Court Road, Mar 23, 1785

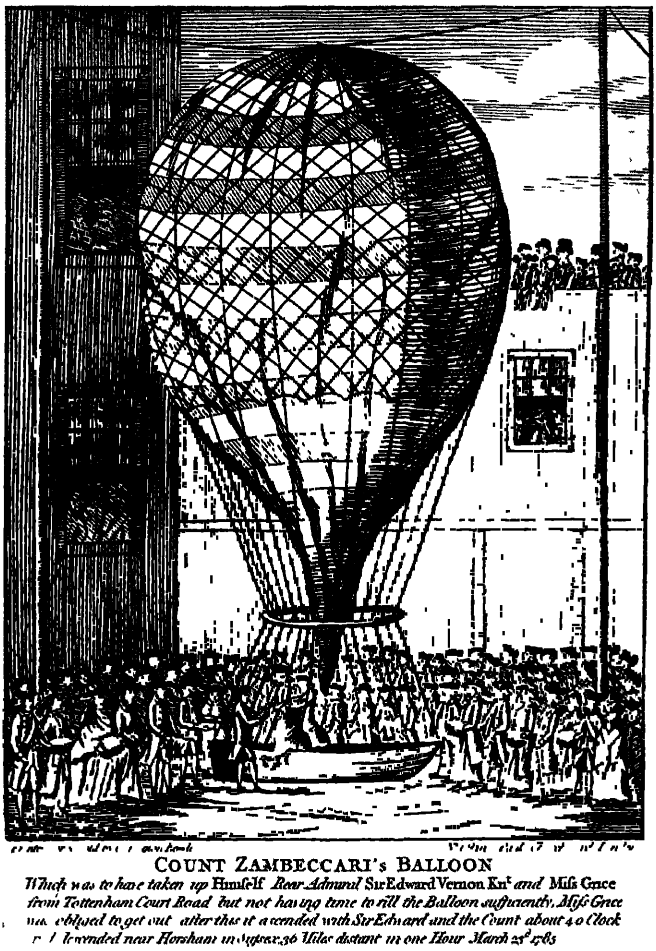


Fig. 52. ZAMBECCARI'S FIRST ASCENT, Mar. 23, 1785.

Quarters past Three o'Clock, amidst the Acclamations of an assembled Multitude of Spectators of every Rank. It went in the Direction of S.W. by S. and so rapidly, that in 20 Minutes time it was so far removed as to be just discernible in the Sky, which was very clear; The Violence of the Wind during the filling of the Balloon, not only damaged the Net in various Parts, but likewise broke the Glass at the lower Part of the Machine, through which the String of the Valve passed, in Consequence of which a Piece of Silk was hastily adapted to stop that Aperture, in doing which the String of the Valve was left within the Balloon, so that there was no Method left of opening the Valve, and consequently of descending at Pleasure; and as the Balloon had a great Degree of Levity, it ascended rapidly until it had passed far above the Clouds. Here the Sun shone very bright, and the vivifying Heat of its Rays rendered the Air agreeably warm, but whilst we were admiring the Beauty of the sublime Prospect, three of the Cords, which held the Boat, gave Way, almost at the same Time, which Accident, added to the Admiral's Desire of approaching nearer to the Surface of the Earth, determined me to use every possible Means to descend, and as it was out of my power to open the Valve at the Top of the Balloon, I thought proper to cut the Silk Tubes, which immediately gave the necessary Exit to the inflammable Air, as the Balloon was already much distended; and, in order to accelerate this Evacuation, I threw overboard the remaining Sack of Sand, imagining, that the Balloon, being lightened, would ascend much higher; the inflammable Air of course, rarefying itself farther and farther, would come out more easily, and afterwards, the least Increase of Cold would determine the Machine to descend. The Balloon went so high, that the Clouds appeared at a great Distance below, and the Quicksilver in the Barometer fell to 20·8 Inches, whereas on Earth it stood at about 30·4 Inches. In descending, we passed through a dense Cloud, which poured Snow upon us, and felt very cold. At last we descended rather rapidly, but quite safe, at 35 Minutes after Four o'Clock, in a ploughed Field, three Miles beyond Kingsfield, near Horsham, Sussex, distant 35 Miles from London, which Distance we travelled in less than one Hour. The Balloon, Boat, &c., being properly secured, we set off for London, where we arrived at Eleven o'Clock the same Evening. Three remarkable Observations were made during the aerial Excursion, which the Limits of a News-Paper will barely allow to be mentioned:—The first is, the Balloon kept continually turning round its vertical Axis, generally very slowly, but sometimes so rapidly, as to make each Revolution in about four or five Seconds. The second is, a peculiar Noise was heard in the Clouds, somewhat like what is produced by the Wind among the Trees, though of a shriller Tone. And lastly, in descending through the Clouds, which was very rapidly, we felt a considerable cold Wind, which agitated the loose Ropes, and other Things about the Machine. The Difference between 30·4 Inches and 20·8 Inches in the Height of the Barometer, is, according to Mr. de Luc equivalent to 10,000 Feet, or 3,332 Yards of Elevation.'[1]

[1] From a contemporary newspaper account in the Cuthbert Collection.

His Subsequent Failure, May 3, 1785,

Towards the end of the next month Zambeccari advertised a second ascent to be made with 'a Field Officer in His Majesty's Service', for the purpose of trying an invention for 'keeping Balloons in a Horizontal Direction', without the usual method of recurring to the valve or discharging gas—an invention which it was claimed would be almost certain to succeed, and which would prove to be 'the most substantial Aerostatic discovery hitherto made'.[1] The character of the invention is not known and apparently was not tested, for the second ascent attempted on May 3rd ended in a fiasco. The failure was attributed to the escape of gas through a rent at the top of the balloon, whereupon the populace seeing that no ascent was possible gave vent to their disappointment by indulging in a riot.

and Later Adventures, 1785–90.

As in other similar cases this failure put an end to Zambeccari's aerostatic endeavours in England, and he soon afterwards found his way to Russia, to embark on a new career of naval adventure. Favoured by Prince Potemkin—who, as chief favourite of the Empress Catherine II, wielded considerable powers—Zambeccari was given the rank of lieutenant in the Russian Navy. Shipwrecked when on service in the Dardanelles, he was captured by the Turks, and endured two and a half years of imprisonment between September 1787 and January 1790. Even in confinement, however, the subject of ballooning continued to occupy his mind, for while in prison he wrote a treatise on aerostatic machines, eventually published in 1800 at Bologna.[2] On his release he travelled to Madrid to seek pardon, but being ill received he returned penniless to Italy, where, however, he was able to renew his ballooning adventures. After various ascents from Bologna he had a terrible experience with two companions in the Adriatic, in October 1804, and narrowly escaped drowning.[3] His death occurred near Bologna on September 12, 1812, when, in an endeavour to save himself, he leapt from the car of a flaming balloon—constructed on the dangerous principle of a combined gas and hot-air machine—and, like Pilâtre de Rozier, was killed on the spot.[4]

His Death in a Balloon Accident, Sept. 12, 1812.

Thus ended in tragic circumstances consonant with an adven-

[1] The 'Field Officer' was most probably Major Money. (Cf. Ch. VIII, p. 181.)

[2] Zambeccari (Conte F.), *Saggio sopra la teoria e pratica delle macchine aereostatiche*, Bologna, 1800; *I. L. A*, no. 1096.

[3] See *I. L. A.*, nos. 1103, 1107, 1109, 1125, &c. Also Marion, (F.), *Wonderful Balloon Ascents*, 1888, p. 146.

[4] Ambrosini (R.), *L'Aereonautica a Bologna*, Bologna, 1912.

FIG 53 COUNT FRANCESCO ZAMBECCARI

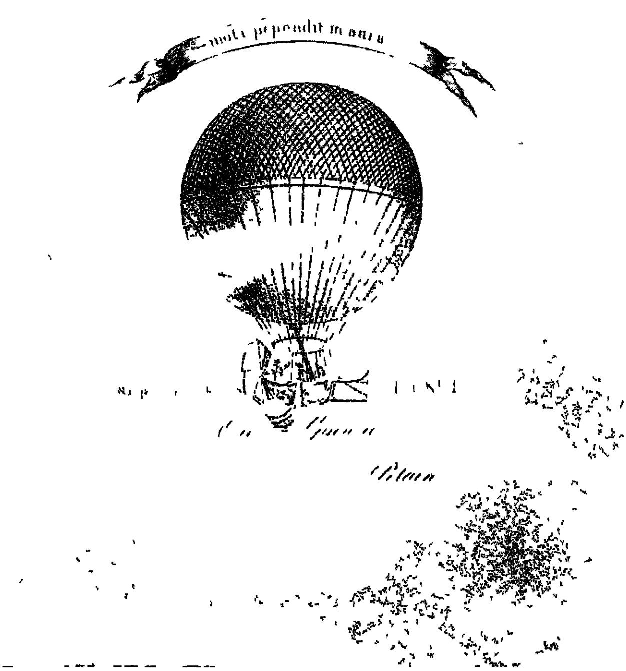


FIG 54 Admission Ticket for Dr. Potain's Ascent, Dublin, June 17, 1785.

turous and romantic career, the story of a daring pioneer of the free balloon. He was probably the first sailor to adapt his skill as a pilot on the sea to that more spacious but lesser known element, the air, and in so doing his sailor-like experiences doubtless stood him in good stead. Indeed as compared with his countryman, Lunardi, one may well believe he was the better, if the less fortunate man—his enthusiasm was of a more impersonal character, and his courage of a robuster kind. If his endeavours to exploit the then unknown possibilities of the balloon left no special mark, it is to his honour that his adventurous career afforded inspiration, nearly one hundred years later, to a great pioneer of 'heavier-than-air' flight—so strangely does destiny deal with the influence of men, long after the immediate result of their little doings has passed away. For it is recorded of Otto Lilienthal that the reading of *The Travels of Count Zambeccay*—his name, even, was not correctly remembered—afforded the initial stimulus to that intense enthusiasm for aeronautics which, though it cost Lilienthal his life, assured the final success of mechanical flight.[1]

Dr. Potain attempts to cross the Irish Sea, June 17, 1785.

One other aeronaut of foreign origin comes within the scope of this chapter, though only by reason of a single notable exploit—the first attempt to cross the Irish Sea by air. The venture was made from Dublin on June 17, 1785, by Dr. Potain, a Frenchman, apparently then living in Dublin. Very little is known of the ascent—so little, indeed, that Monck Mason at one time ignored it, owing to his inability to find any one who recollected even the name of the aeronaut. Subsequently, however, he handsomely acknowledged the error in his *Aeronautica*, 1838, and expressly apologized to Potain (who was then living in Paris, and to whose character as 'a most respectable veteran of aerostation' Monck Mason wished to do justice) for the omission.[2] Potain's balloon was fitted with wings and a rudder, as well as a propeller or 'fly', the mechanism bearing a strong resemblance to that used by Blanchard, the 'boat' or car of wicker-work (weighing 160 lb.) being rendered waterproof by a covering of oilcloth, which it was hoped would keep it afloat for a considerable time even in a brisk sea.[3] Nevertheless, the further precaution was taken of fitting

[1] Lilienthal (O.), *Bird flight as the Basis of Aviation*, by A. W. Isenthal, 1911, p. xi.

[2] Monck Mason, p. 270.

[3] Cf. Depuis Delcourt (p. 79), where it is stated by the author (who knew Potain) that the balloon was an improvement on the 'machine hélicoïde de Blanchard' and that the crossing was effected—the latter statement being erroneous.

a net within the car, so that if necessary the latter could be cut away and dropped. On June 10 a notice was printed and issued to 'all owners of Fishing Vessells and Sea Boats' in certain neighbouring Irish and English harbours, announcing that Potain would ascend on the 16th inst., for the purpose of crossing from Dublin to Great Britain, and requesting assistance in case of need near the Welsh coast, it being explained that 'the Balloon will probably go before the wind'—a clause which clearly suggests that Potain had doubts as to the efficiency of his directional gear. The ascent was made from Marlborough Green,[1] and after being carried at first north-east, the balloon at a higher elevation was subsequently driven directly south, and in about an hour's time descended in the hills near Powerscourt, about sixteen miles from Dublin. Owing to some accident to the hoop Potain became entangled in the cords and was dragged along within a few feet of the earth for nearly two miles, though he escaped with nothing worse than considerable bruises. Finding himself among the mountains of Mullinaveague, the aeronaut (who could not speak English) found some difficulty, first in finding any house, and then in revealing who he was. The question of identity he overcame by repeatedly saying, 'Potain', 'Potain', whereupon—the news of his daring venture having roused widespread interest and enthusiasm—the '*aeronaut* met with a cordial reception'.

Potain apparently made no further ascent in Ireland, but he retained his interest in ballooning, and nearly forty years later he published in Paris a *Relation aérostatique dédiée à la Nation Irlandaise*, 1824, which contained a portrait of himself and a view of his balloon, bearing the words, 'Le Premier qui tenta le Passage du Canal St. George de Dublin en Angleterre'.[2]

[1] A subscriber's ticket (Fig. 54) was one guinea, and it contained a view of the balloon, surmounted with the motto, 'Mota pependit in aura'. It was reprinted in the *Relation*.

[2] The words quoted have commonly led to the assumption that the venture was accomplished—a statement to that effect is one of the very few errors in the admirable *I. L. A. Catalogue*, 1912, p. 508. The above account of Potain's venture is gathered from contemporary news-cuttings in the Cuthbert and Patent Office Collections.

CHAPTER VIII

BRITISH AERONAUTS PRIOR TO 1800

THE ballooning vogue which followed immediately on the discovery of this method of aerial navigation in 1783, clearly owed its incentive to two main factors : the novelty and inherent attractiveness of the invention, and the great hopes which—too readily, it is true—were entertained as to its utility. On the one hand stand the records of vast crowds of people drawn together time after time, both on the Continent and in Great Britain, to witness the wondrous sight of a ' globe ' or ' machine ' ascending ' into the air by itself '—to use a simple but expressive phrase from an account of one of the earliest experiments in France. On the other, Benjamin Franklin's pregnant counter question to one who doubted the possibility of any use being made of balloons—' A quoi sert l'enfant qui vient de naître ? '—may be set against the more immediately pertinent comment made by Johnson, to the effect that balloons could serve no practical purpose until they could be directed.

But if the fascination of balloon ascents as appealing to the curiosity of the masses led to their exploitation as commercial ventures—and there can be no doubt that such was the case—it is in the main fair to say that the earliest aeronauts in all countries were men drawn to undertake exploits in the air after the manner and in the spirit of all true pioneers in other fields of human endeavour—notably in the exploration of the world's vast and unknown spaces on sea and land. Of aeronauts in the latter category Major (afterwards General) John Money is certainly an early example in England.

General J. Money (1752–1817).

Though the possibilities of the balloon in military operations both for purposes of reconnaissance and—more actively—in the dropping of bombs, were recognized at a very early date, to Major Money belongs the distinction of being the first in England to consider military aeronautics from the point of view of actual experience. Born in 1752 Money began his military career in the Norfolk Militia,[1] and between the time of his joining the regular army in 1762, to his retirement on half-pay in 1784, he saw

[1] The only account of Money known to the writer is in the *D. N. B.*, vol. 38.

considerable service in various theatres of war. In 1777 he served with Burgoyne during the disastrous descent on Albany from the north—an expedition cited by the author of *The Air Balloon*, 1783, as one in which observations from a balloon would have frustrated the ambush laid by the enemy.[1] Taken prisoner in September 1777 Money was not released until the end of the war, and though his active career in the British Army was closed he offered his services in 1792 to the rebel party in the Austrian Netherlands, was granted a commission as major-general, and placed in command of 4,000 men at Tirlemont. Though lacking any signal ability as a great commander, Money had some of the best qualities of a British regular officer, amongst them a keen interest in his profession and a sincere regard for the interests of his men.[2] In later life he took up farming, but still returned from time to time to the consideration of current military affairs, his writings—in which he drew largely on his own varied experiences—being marked by a forcible directness and cogency of argument, and a proverbial impatience with War Office arm-chair conservatism. In 1806 he addressed a letter on the defence of London against the threatened French invasion to William Windham, who had been member for Norwich between 1784 and 1802, and with whom Money's interest in ballooning formed a mutual tie.

His Ascent with Lockwood, June 3, 1785.

Money's first ascent was that made from Tottenham Court Road in company with Jonathan Lockwood, the proprietor of the balloon, and George Blake, of the Navy.[3] This so-called 'British Balloon' was said to be 'infinitely the most magnificent hitherto constructed', and being inflated to three-quarters of its capacity—an operation in which George Biggin and Pilâtre de Rozier assisted—had a lift of over $5\frac{1}{2}$ cwt., including 64 lb. of ballast, a quantity which proved to be insufficient. On being released soon after

[1] *The Air Balloon*, 1783, p. 26. Money himself likewise refers to this expedition in his *Short Treatise*, 1802, p. 12.

[2] Flogging for desertion was strongly deprecated by Money as a cruel punishment. His suggested alternative that for a first offence a D should be tattooed on the arm, and on the forehead for a second offence, with death or 'being sent to the African Corps' for a third, is typical of Money's occasional lapses in sound judgement.

[3] Monck Mason, misled by a newspaper report, erroneously states in his list of ascents (p. 267) that Sir Edward Vernon was also a passenger. In the *Public Ledger* for June 4, it was reported that the third occupant was a son of the Rt. Hon. Hans Stanley. (Cf. *D. N. B.* under Stanley (Hans), vol. 54, p. 69.) Blake made another ascent (from ground behind the Lyceum in the Strand) in the same balloon, enlarged, on June 2, 1786. Accompanied by another naval officer named Redmill they landed at Yalding, in Kent.

1 o'clock, it rose very rapidly and expanded to a dangerous extent—an expansion which Lockwood cautiously suggested arose '(presumably) from the rarefying power of the sun '.[1] From an observation of the sun made by Blake with a Hadley's sector, the elevation 'worked out by Euclid's Elements and Sir Isaac Newton's Principia', is said to have been three miles and a quarter. Shortly afterwards, having valved a considerable quantity of gas and being without much ballast, the balloon fell rapidly and came down on some large trees in Mileman's Wood, twenty-one miles from London and two miles from Abridge in Essex. Owing to the loss of gas it was found that the balloon would not again rise with all three aeronauts, whereupon some little dispute arose as to who should get out. Money and Blake protested that as an army officer and a naval man respectively, it was undesirable that they should retire at this somewhat dangerous juncture, while Lockwood as warmly argued that he should remain just because he was not of their professions. Finally they agreed to draw lots, with the result that it fell to Blake to retire, and after having amicably enjoyed lunch in the gondola—which was still supported in the trees, with the balloon floating above—Money and Lockwood reascended. During the flight a test was made of an invention by Money for hindering balloons from ascending higher than might be agreeable, and bringing them down without loss of gas, and though obviously it was inefficient Lockwood, while claiming that the test was not unfavourable to the device (which was not in any way described), admitted that too little ballast was taken for a fair trial. On the other hand he averred it was 'an absolute fact' that an inverted jib-sail fitted to a mast as part of the equipment of the balloon, had an effect in 'occasionally checking the vertical inclination'. For three-quarters of an hour the aeronauts were out of sight of the earth, during which time they were much impressed with the glorious effects of cloud-land—'its aerial Billows, hoary Mountains, and frosty Plains'—and observed the 'Bur or Circle' which appeared round the shadow of the balloon.[2] Eventually Lockwood made a safe landing about eight miles from Maldon

[1] See *Mr. Jonathan Lockwood's Account of his Aerial Excursion . . . with the British Balloon*, 4 pp., dated from the Lyceum in the Strand, June 8, 1785 (Patent Office Collection, vol. viii, p. 27). Lockwood did not pretend that his 'artless narrative' contained 'much scientific or philosophical intelligence'.

[2] Baldwin (*Airopaidia*, 1786, p. 60), in his ascent in Lunardi's balloon at Chester in September the same year, also noted 'an Iris encircling the whole Shadow' of the balloon. A recent illustration of this oft-noticed phenomenon is to be found in the photograph of the

in Essex. Returning to town the same night Money and Blake dined with Lord Orford at High Beech, Epping, in company with Lunardi's patron, George Biggin, and Pilâtre de Rozier. It was just ten days later that the latter was destined to meet his death in attempting a Channel crossing, thus achieving the unique twofold distinction, at once honourable and tragic, of being the first man to ascend into the air and the first also to sacrifice his life in the cause of aerostation.

Ascent from Norwich, July 22, 1785.

During the following month Money made a solo ascent from Norwich, which nearly ended in disaster, and which, by reason of the fine mezzotint engraving of his descent into the sea after the drawing of P. Reinagle, became widely known.[1] It had been announced that Money would again be accompanied in this ascent—which was made in Count Zambeccari's balloon—by Blake and Lockwood, but on the appointed day, namely July 23, owing to some inefficiency in the inflation, the balloon would not carry more than one aeronaut. As a vast concourse of people had assembled, it was decided that Money should ascend alone in order to prevent any disappointment. The day was very calm, the leaves on the trees in Quantrell's Gardens (from which the ascent was made) scarcely stirred, and the balloon, rising shortly after 4, drifted slowly NW., only to be carried SE.—by an 'improper current' as a contemporary account naively records—on rising to a high elevation. On nearing the coast-line Money tried to valve gas, but it is said that a piece of silk had been sewn over the valve during inflation, and consequently it would not open.[2] The balloon was carried thus over Pakefield, near Yarmouth, and subsequently—about 6 o'clock, after being in the air over two hours—Money found himself in the sea, something like twenty miles from the land. The boats which had put out from Lowestoft and Southwold had meanwhile returned under the impression that Money must inevitably be drowned. His escape was indeed a narrow one. In the growing darkness he struggled for nearly five hours to keep afloat, during which time his hopes of rescue

shadow of the rigid airship R. 34 taken by Major J. E. M. Pritchard, O.B.E., A.F.C., on the historic Transatlantic flight in July 1919, and reproduced in Air-Commodore E. M. Maitland's *Log of R. 34*, 1921.

[1] Lockwood Marsh, no. 56. Another similar mezzotint—'The Providential Escape of Major Money'—of which the writer has only seen two impressions, was published without names of artist or engraver (Fig. 55).

[2] Though a primary cause of his disastrous descent, the fact that no gas could escape through the valve doubtless helped to save him in the end. Tissandier (vol. i, p. 103) says the cause of the descent was never understood.

Fig 55. THE RESCUE OF MAJOR MONEY OFF YARMOUTH, JULY 22, 1785

vere dashed, first by the callous indifference of the crew of a Dutch 'raft, and subsequently when a boat which had chased him for wo hours bore away on the approach of night. Then it was that lespair wellnigh overcame him—as he afterwards recorded Money :ven wished 'Providence had given [him] the fate of Pilâtre de Rozier, rather than such a lingering death'. As the balloon got ,orn by the waves and the gas gradually escaped, Money, supported by the hoop and holding on to the cords with lacerated hands, sank inch by inch until he was breast high in the water. When finally picked up at half-past eleven by the revenue cutter *Argus*, he was in such a weak condition that he had to be lifted out of the water, but on being put to bed, and after two or three glasses of grog—which he said were 'by far more delicious than champagne' —he slept soundly. He was put ashore at Lowestoft early next morning, when the news of his unexpected recovery put the town in an uproar of delight.

His Treatise on Military Balloons, 1803.

The third ascent which Money made in his short aeronautical career is not on record, but his interest in military balloons remained, and some years later, in the leisure of his retirement, he wrote *A Short Treatise on the Use of Balloons and Field Observators in Military Operations*, 1803—a subject he claimed as one which had 'never been touched on before in this Country'. His ideas were aptly, though freely, expressed in verses (quoted by Money) written by 'a noble Lord', wherein a contrast is offered between those who 'for subscriptions mount in air', and those who (like Money) strove to demonstrate the utility of balloons.

> Great use, he thought, there might be made
> Of these machines in his own trade;
> Now o'er a fortress he might soar,
> And its condition thence explore;
> Or when by mountains, woods, or bog,
> An enemy might lay *incog*,
> Our friend would o'er their station hover,
> Their strength, their route, and views discover;
> Then change his course, and straight impart
> Glad tidings to his chieftain's heart;
> Such lights convey, such knowledge gain,
> As might decide the whole campaign.

As a proof of the practical utility of balloons in military reconnaissance, Money quotes the acknowledgement of General Jourdan that

his victory over the Allied Armies at the Battle of Fleurus on June 26, 1794, was greatly due to the information conveyed to him by signals made by Coutelle from his balloon 'L'Entreprenant'. He also quotes the lesser known case of the victory won by the

A

SHORT TREATISE

ON THE USE OF

BALLOONS

AND

FIELD OBSERVATORS

IN

MILITARY OPERATIONS

By MAJOR GENERAL MONEY

LONDON

Printed by C Roworth, Bell Yard, Fleet Street,

AND SOLD BY T EGERTON, MILITARY LIBRARY, WHITEHALL

1803

Fig. 56.

French over the Austrians on the Ourthe River, near Liège, when observations from a balloon—'one would have supposed', so Money was told on the spot by an eye-witness in the Austrian position, 'that the French General's eyes were in our camp'—enabled counter dispositions to be made, with the result that the attack which followed ended in a disastrous defeat for the Austrians.

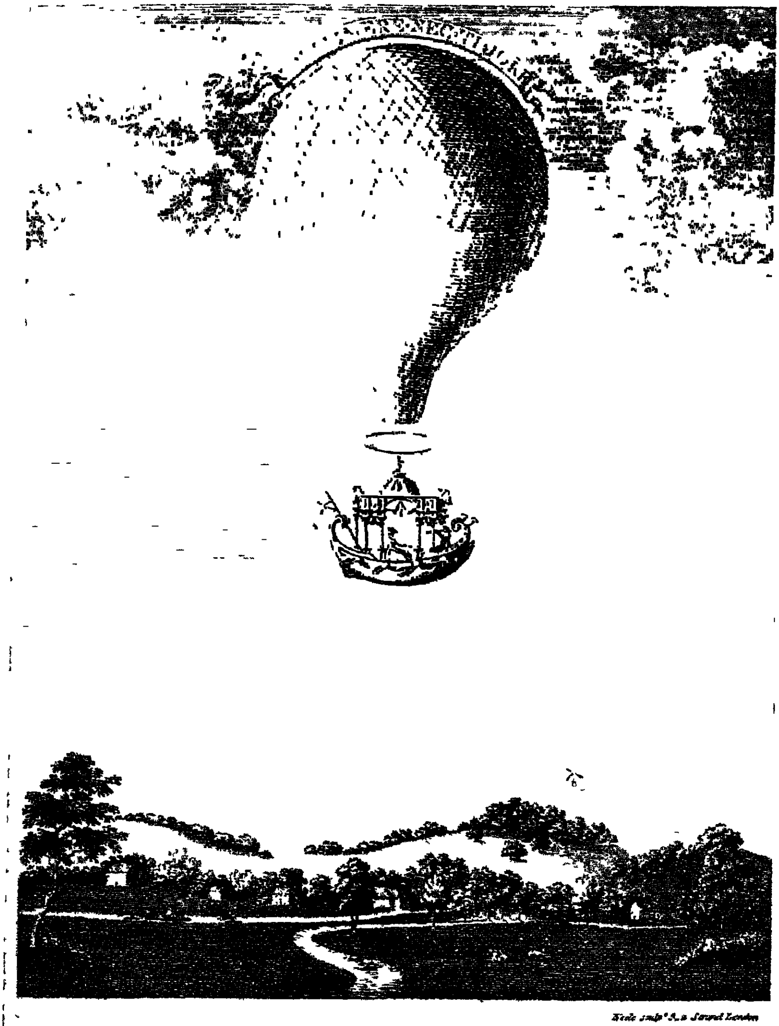


FIG 57 JAMES DEEKER'S ASCENT FROM NORWICH, JUNE 1, 1785.

The gist of Money's argument lay in the contention that the use of balloons for reconnaissances in warfare would frequently give a commander that knowledge of his adversary's strength and position, which is of such vital importance but is so difficult to obtain. His opinions on the subject were strongly held—' should there not be a single officer in the British Army ', he wrote, ' whose thoughts are in unison with mine, yet shall I ever think that a balloon and field observators may, at certain times and in certain situations, be of great use, and that eventually from them may be obtained intelligence of the highest importance '. But while Money realized that a captive balloon in a wind would be of little use—he demonstrated that simple fact in the *Treatise* by a plate of a captive balloon floating upright ' in a calm ' and driven aslant ' in a wind '—his limited experience had not enabled him to appreciate the technical and mechanical objections which, for a long time to come, rendered military ballooning impracticable.[1]

Deeker's Ascent from Norwich, June 1, 1785.

The exploits of another early aeronaut, James Deeker, are also associated with Norwich, on account of the ascents he made there in June 1785. Little is known of Deeker beyond the fact that he sold air-balloons at a shop in Berwick Street, Soho, and had the reputation of being a very clever and ingenious mechanic.[2] Though it has been seen that Deeker had had some experience in the inflation of a balloon (when assisting Blanchard at Dover earlier in the year), the only ascents he is known to have made are the two of which an account was written by Edward Rigby and published anonymously at Norwich under the title of *An Account of Mr. James Deeker's Two Aerial Expeditions*, 1785.[3] Deeker's so-called ' Royal Balloon ' having been inflated to an extent which gave it a lift of 458 lb., the aeronaut and a girl of fourteen, named Weller, climbed into the car. Unfortunately shortly before 4 o'clock a violent storm came up, and the lower part of the balloon was

[1] Money's treatise is in the form of a letter to the Rt. Hon. Charles Yorke (at that time Secretary for War) as the proper person to whom this consideration of a ' perfectly military ' subject should be addressed. The Field Observators were in the form of portable wooden staging or look-out towers, about 40 feet high.

[2] Mr. G. A Stephen, of the Public Library, Norwich, informed the writer that no local references to Deeker could be found beyond the accounts of his two ascents. Both Hatton Turnor and Monck Mason merely mention him in the list of ascents (copied from Dupuis-Delcourt's *Manuel d'Aérostation*, 1850) as ' Decker, Norwich '. See also Forster's *Annals*, p. 27. Deeker sold experimental balloons at 59 Berwick Street, Soho, at prices ranging from 5*s.* for one 3 feet in diameter, ' neatly gilt ', and gas for the same 3*d.*, to two guineas for a 12 feet size, gas 5*s.*

[3] Published with a frontispiece (Fig. 57.)

torn, thus allowing of a considerable escape of gas. The damaged envelope was, however, drawn together and secured with strong cord, but this diminished the capacity of the balloon and necessitated shortening the cords to which were attached the hoop and car. The storm now burst, with the accompaniment of lightning and thunder, and a further rent was made by the wind, the resulting escape of gas reducing the lift to 300 lb. Though Miss Weller in her plucky determination not to be denied had again got into the car, she had eventually to be left behind, the balloon shortly after rising with Deeker alone. The storm having passed over allowed of an easy and almost perpendicular ascent, but Deeker soon found himself in difficulties, for the rent in the balloon increased to such an extent that it seemed (to use his own expression) ‘ large enough to admit a post chaise ’. Standing on the edge of the car Deeker caught hold of the torn envelope and tied it together as best he could with a handkerchief, but a rapid fall was inevitable, as he had used practically all his ballast on first rising. By hanging to the hoop, Deeker escaped injury on landing near Loddon, not more than about ten miles from Norwich.

Second Ascent from Norwich, June 23, 1785.

On the occasion of his second ascent there was again a high wind, and to guard against a recurrence of the former incident the balloon (against Deeker's own judgement) was not so fully inflated, which meant a second disappointment for Miss Weller. Ascending with 40 lb. of ballast the balloon struck the trees in Quantrell's Gardens, but Deeker rose safely in a northerly wind. The normal, though on this occasion somewhat rapid, series of ascensions and falls which followed, prevented him from making accurate observations owing to the irregular movements of the barometer—a curbed one by Nairne and Blunt, ‘ most ingeniously contrived for this occasion ’. After a flight of three-quarters of an hour Deeker made a landing at Topcroft, twelve miles from Norwich, some horsemen who had followed him helping to secure the balloon.[1]

Deeker at York, Aug. and Sept. 1785.

The only other ascents with which Deeker is known to have been associated were attempted at York on August 30th, when his balloon was used in conjunction with a man named Weller, for an ascent from Kettlewell's Orchard. Weller ascended alone, and in failing to clear the adjacent buildings was dashed violently

[1] Rigby states in the preface to his *Account* that he was present at the ascents, and that the particulars he gives—which first appeared in the *Norfolk Chronicle*—had been obtained from Deeker himself. At the end of the narratives Rigby added some useful technical notes on ballooning.

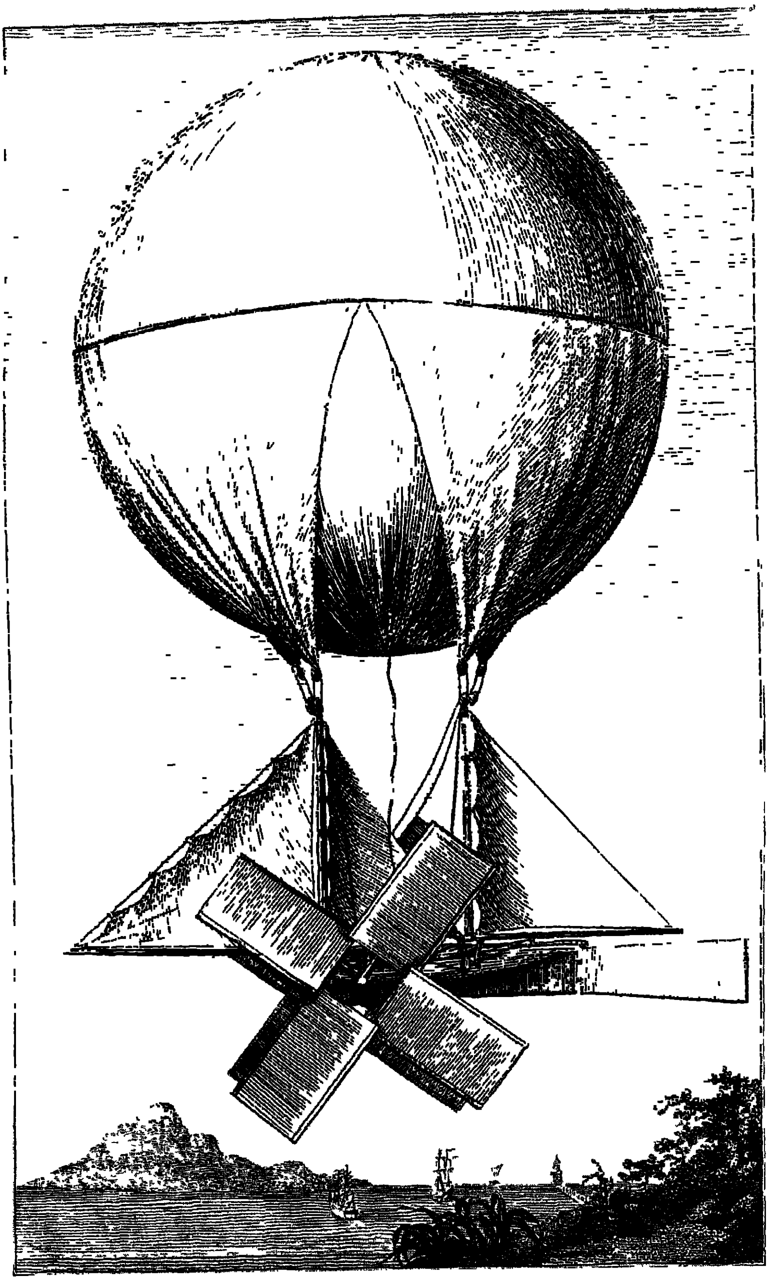


FIG. 58 CROSBIE'S 'AERONAUTIC CHARIOT'.
Exhibited in Dublin, Aug 1784

against a chimney. Fortunately the balloon broke away and Weller, left in the car on the roof of the building against which the balloon struck, escaped from a dangerous predicament without serious injury. Early the following month, Deeker himself undertook an ascent from in front of the Grand Stand on Knavesmire, but owing to some failure in the inflation, the disappointed crowd broke in and cut loose the balloon—a *contre-temps* which may well have discouraged Deeker from further aeronautical exploits.

Richard Crosbie, First Irish Aeronaut (1755–1800).

The earliest aerostatic experiments of any consequence made in Ireland were those conducted in the autumn of 1784 by Richard Crosbie. Crosbie was born at Wicklow, and after a college education joined the army, which he is said to have left owing to loss of means.[1] Becoming interested in Montgolfier's discovery, he appears to have been one of the first in the United Kingdom to examine with some thoroughness the problems involved in navigating balloons. From experiments made in a stream of water with mechanism of his own designing, he realized at an early date that sails fitted to a balloon were not analogous to sails as used in a boat, owing to the fact that a balloon moves wholly in one element while a boat moves in two elements of different density. Nevertheless he hoped by the combination of divergent forces obtained from the use of ' flyers '—like the sails of a windmill on a small scale, actuated by hand—and two fore and aft canvas jibs, to be able, with the help of a rudder, to direct a course over half the points of the compass—but not more. This ' Aeronautic Chariot ', resembling ' in some respect a boat or wherry with two masts ', and made of a light frame of wood covered with thin silk or linen, with a rudder of the same materials, was constructed and exhibited at Ranelagh, near Dublin, during August 1784. Crosbie intended to test it beneath a hydrogen balloon of 40 feet in diameter, but there is no record of his having done so. He did, however, inflate a balloon during the exhibition of his ' chariot ', which—held captive by a cord—was allowed to ascend ' to a prodigious height, whenever the calmness of the weather favoured it, sometimes with a weight, and at others with some animal suspended '.[2] Subsequently he released the balloon at Ranelagh whence it was blown out

[1] *Hibernian Magazine* for Jan. 1785. There is no mention of Crosbie in *Astra Castra* beyond his name in the list of ascents.

[2] Walker's *Hibernian Magazine* for Sept. 1784, p. 489, ' with an exact drawing.' (See Fig 58)

to sea and fell on the Isle of Man, this being the first notable experiment of the kind in Ireland.

His First Ascent from Dublin, Jan. 19, 1785.

By the middle of January Crosbie had constructed a large balloon, beautifully painted with the arms of the City of Dublin, and on the 19th of that month, after a postponement from the 10th on account of rain, and despite some difficulties with the inflation, he ascended from Ranelagh in the presence of 40,000 people, dressed in 'oiled silk lined with fur, a waistcoat and breeches of quilted satin, morocco boots, and Montero leopard skin cap' —an attire more ostentatious than fitting, even for so notable an occasion. Rising rapidly his balloon was out of sight in three or four minutes, but Crosbie (doubtless in view of his nearness to the sea) shortly afterwards opened the valve and made a safe landing when just on the point of passing over the coast-line.

Second Ascent, May 12, 1785.

A second ascent—this time from the Palatine Square of the barracks in Dublin—had a more exciting termination. It seems that some difficulty was again experienced in giving the balloon sufficient lift to carry Crosbie, who was a man of heavy build, as his portrait engraved for the *Hibernian Magazine* sufficiently testifies (Fig. 59). After rising above the roofs of the adjacent houses the balloon fell to earth so rapidly as to cause great consternation, but no sooner had Crosbie alighted than a young officer, Richard McGuire, sprang into the car, and promptly threw out a quantity of ballast, whereupon the balloon ascended 'with much awful splendor' and drifted away in a north-easterly direction. At a higher elevation the balloon—which was plainly visible to the spectators for a long time, the day being fine with a cloudless sky—entered a westerly current and was carried towards Howth and across the Channel. When nine miles out to sea it fell rapidly, and McGuire found himself in a similar predicament to that experienced a little later by his brother officer, Major Money (Fig. 60). Fortunately for the rash and inexperienced aeronaut, Lord Henry Fitzgerald immediately gave instructions for a wherry to put to sea, having conjectured from the rapid descent 'that the balloon had cracked'—a quaint expression used by a contemporary journalist, and supported with characteristic assurance and credulity by the statement that the conjecture 'happened to be the fact'. McGuire was apparently thrown out when the car struck the water, for by the time the rescuers came up with him the balloon was some distance away, and he himself greatly exhausted with swimming

Fig. 59 RICHARD CROSBIE.
The First Irish Aeronaut, 1785

Fig. 60. RICHARD McGUIRE
Ascended in Crosbie's Balloon, 1785

bout in the open sea for over forty minutes.[1] He had, however, ntirely revived by the time he landed, and on being received by he Duke and Duchess of Rutland, McGuire enjoyed the unique istinction of being knighted by the Lord Lieutenant as a reward or an exploit which, though certainly exhibiting admirable pluck nd spirit, was also characterized by an impulsive rashness which ıvited disaster.

Crosbie having conceived the idea of attempting to cross the rish Sea, the attempt was made on July 19th. A circular icker basket was fitted as a substitute for the usual ' gallery ' or boat ', and round it were fitted a number of bladders to afford ıcreased buoyancy in the event of falling in the sea, as well as large rudder. He started with 300 lb. of ballast, but at the outset ad to discharge 56 lb. in order to rise above a wall in the gardens ' the Duke of Leinster's house in Dublin, whence the ascent was ade. Thereafter he rose in an easterly current to a great height, ie mercury in the barometer sinking entirely within the bulb, , which time (as he afterwards recorded) Crosbie suffered from tense cold, an uncomfortable ' prepulsion on the tympanum of the ırs ', and the much more rare experience of sickness. He con-·quently opened the valve, and now moving in a north-easterly rection he passed through heavy clouds—at which time there was ghtning and thunder—and descended rapidly into the sea. The ladders proved a useful precaution, and with the balloon acting ; a sail he ' went before the wind as regularly as a sailing vessel '. rosbie was eventually picked up by a barge from Dunleary— hich towed the balloon behind it—and was landed safely about) o'clock the same night.[2]

Attempted Channel Crossing from Dublın, July 19, 1785

A more ambitious over-sea voyage had been projected earlier the year by Stuart Amos Arnold, a disabled purser of the Navy, ho joined with a man named Whittaker in what was clearly financial speculation—one, moreover, which ruined both partners. he original idea was to undertake a balloon voyage from London › Paris, though for this was eventually substituted the more ᴄciting attraction of a parachute descent, which—had it proved

Arnold's ' Royal George ' Balloon, Aug. 1785.

[1] A large mezzotint of this ıncıdent was engraved by W. Ward after Barralet (See Lock-ood Marsh, no 52). Tıssandıer (vol. ı, p. 103) refers incorrectly to ' un ȷeune aéronaute mmé Quer '.

[2] The only other ascent recorded to have been made by Crosbıe was from Lımerıck April 27, 1786. In an anonymous poem entıtled *Aerıal Voyage*, Dublın, 1785, ıt ıs ımed that Crosbıe (to whom the verses are ınscribed) started the ıdea of ' aerial excur-ons ' as early as 1773.

successful—would have been the first in this country. The character of Arnold's undertaking may, perhaps, best be set out in the words of his own advertisement, as it appeared on March 21, 1785 :

ROYAL GEORGE BALLOON

Mr. Arnold, late Purser of his Majesty's sloop, Cabot, with the most profound respect, takes the liberty to acquaint the Nobility and Gentry, that he has attempted the construction of a Balloon, the conjugate diameter or axis of which will be equal to the breadth of his Majesty's ship, Royal George, now building at Chatham, and will contain more than one hundred and twenty-three thousand cubic feet of rarified air ; upwards of ten and half times more than the quantity of inflammable air contained in the balloons of Mr. Blanchard and Mr. Lunardi.

With this balloon, by the blessing of Providence, Mr. Arnold, in company with his Daughter, and a Gentleman, purposes making the Grand Aerial Journey from London to Paris ! the first fair wind, after the 30th day of April next, to effect which, (being an utter stranger in France, except the sea-coast, where he had the honour of leaving one of his legs, while fighting the battles of his King and Country) he intends taking his departure from one of the most convenient and conspicuous places in the vicinity of St. James's, about midnight, that he may fall in with the sea-coast at break of day. Mr. Arnold's Balloon, therefore, in order to render his departure equally astonishing, as bold, will be so constructed as, at its ascension, to have a body of light in the centre, which will give it an appearance far more brilliant than the Moon at the Full, and will, by such splendid addition, be the most noble, grand, and sublime spectacle ever exhibited, or perhaps conceived !

But Mr. Arnold, being (from the many misfortunes which he has experienced in the service of his country) unable to complete his Balloon, without the aid of a brave, generous and benevolent public, most humbly begs leave to implore the assistance of the Nobility and Gentry, to enable him to perfect it, and perform a journey yet unattempted, or unthought of ; the sea, in the direction of Mr. Arnold's course, being upwards of three times as far over as from Dover to Calais.

Mr. Arnold is well aware that an undertaking so bold, may not immediately meet that degree of credit which he will venture to flatter himself it merits ; but he has well weighed the difficulties attending it, and so well is he convinced of the want of ability to complete his Balloon being the only material one, that, with the generous indulgence and liberality of the Nobility and Gentry, he will stake his life to the performance of it ; and most solemnly declares that he will never return to London, until he has performed his journey, from London to Paris, in his Balloon, and returned in the same manner.

The Ascent postponed

A month later an announcement was made postponing the ascent until ' the first fair wind ' after May 10th, and again at the

end of June further delay was caused, owing to accidents in the shelter with awnings—an early form of balloon shed—set up to protect the machine. The site chosen was St. George's Fields, close to the Royal Circus (just beyond the Obelisk in the Blackfriar's Bridge Road) which had been completed a few years earlier.[1] Eventually, the London–Paris voyage having been abandoned, Arnold announced that on August 31 he would ascend in his balloon—which he speciously adds had been 'made at the request of several of the Nobility'—for the purpose of sending 'a Gentleman down by a Parachute, when a mile high'.[2] The advertisement given to the venture over so long a time, and the curiosity and excitement created by the incredible adventure of a parachute descent—an exploit hitherto only to be seen when practised with a cat or dog—led to the congregation of an immense crowd.[3] No difficulty was experienced in obtaining the gas necessary for inflation—on the contrary the balloon was so 'tight' just before the ascent that the silk was pressed out between the interstices of the netting (giving it the appearance of 'a piece of quilting') and the slender meshes of the network broke as the result. Arnold and his young son having seated themselves in the car, and Appleby, the daring parachutist, having likewise taken his place—with the careless *sang-froid* characteristic of the British tar—in the basket attached to the parachute, the balloon was released and rose slowly from the ground. Arnold having thrown out ballast, the contemporary reports state that the balloon would have cleared the palings which enclosed the ground but for the parachute which was suspended beneath, the latter striking the fence and being held against it by the lift of the balloon. Thereupon the parachute was cut away, but as a result of the check thus given to the ascension of the balloon it almost immediately struck a cart, Arnold himself and all the ballast being thrown out and the car damaged. Young Arnold was now carried up, to the intense dismay and horror of the

Ascent, with a Parachute, from St. George's Fields, Aug. 31, 1785.

[1] Mrs. Sage, in her *Letter* (p. 7), refers to the Rotunda in St. George's Fields as having been built by Arnold for the 'launching of his Montgolfière Balloon, called the Royal George'. It was from this site that Biggin and Mrs. Sage ascended on June 29, 1785.

[2] The 'gentleman' in question was a sailor named Appleby, a master's mate of the naval cutter *Kite*. (See *European Mag*, September 1785, p. 233.)

[3] Arnold complained bitterly that owing to the congestion of some 400 carriages between the Turnpike and Blackfriars Bridge, and the consequent inability of people to reach the enclosure, he lost between £300 and £400 A.-J. Garnerin was the first man to descend from a balloon in a parachute in October 1797 (see *post*, p. 323).

assembled multitude, hanging to the broken cords of the balloon, from which—with or without the car—it was momentarily expected he would fall. The cries of the populace, added to the acute distress of Arnold himself, must have made a memorable scene. But the agony was of short duration, for after the lapse of a few minutes the balloon burst, and was seen to fall in the direction of Rotherhithe. As a matter of fact the boy fell in the Thames near Rotherhithe Stairs, whence he was rescued by a passing boat, and far from having suffered from the shock of his desperate adventure, he showed his pluck and spirit immediately after his 'severe ducking'—as his father relates—by knocking into the river five men who tried to plunder the damaged balloon.[1]

Some days later Arnold published in the press a letter—in the nature of an apologia—recounting the affair at length and offering quite another and apparently more reasonable explanation of the failure. He relates that the balloon having been expeditiously filled by the help of the 'scientific knowledge' of two friends, Harper and James, he found that by substituting a smaller car he would be able to accede to the urgent request of a gentleman who wished to accompany him. However, by the time the inflation was completed it was seen that over 200 meshes of the net had burst owing to the tightness of the balloon. Realizing that delay would involve great danger, and (to use his own words) 'having received my private Parachute, by which I should have been enabled to have prevented any rapid ascension of the Balloon, after liberating my friend Appleby and his parachute, I permitted George [his son] to come into the Car, and gave word to the people to cast off the Balloon, and conduct it through the masts'.[2]

'On being liberated', the narrative continues, 'the Balloon ascended with velocity amply sufficient to have cleared the Parachute of the fence; but just at that instant a rope, which had been fastened to one of the masts

[1] Contemporary accounts vary, and it is not easy to understand exactly what happened. As an illustration of the erroneous perversions in ballooning records, it may be noted that about forty years later an account of this affair was printed under the heading of 'Balloon Ballast'. In it the parachutist is said to have been 'a little fellow of the name of Appleby, a messenger at Drury Lane', who was thrown out by Arnold into the Thames, in order to allow the balloon to rise above a jeering crowd!

[2] A contemporary engraving (Fig. 61) shows the balloon rising above eight masts, doubtless erected to support canvas hangings for the protection of the balloon, and to suspend the envelope during inflation. Appleby is seen reclining in the car suspended close up under the expanded parachute.

FIG. 61. ARNOLD'S BALLOON AND PARACHUTE, ST. GEORGE'S FIELDS, SOUTHWARK, AUG. 31, 1785.

rom the Balloon, and which, owing to the extreme attention of the company to Mr. Appleby, just as he was quitting the ground, was neglected, hecked the Balloon so violently as to bring it down with amazing velocity nd tho' the rope gave way instantly, yet the Balloon could not recover the hock, till it had dashed the Car against the rails off the road, and thrown me 0 feet from it.'

f Arnold's account is the true one—and, though he was doubtless eady to seize any excuses that could be offered, it seems to be—t is an amusing illustration of the tendency of reporters in all ges to embroider their narratives.

Another curious incident related by Arnold refers to the fact hat during the inflation one of his men fell (presumably from one f the masts) on to the top of the balloon, and lay there for twenty ninutes before a rope could be thrown to him. This gave rise to ears in Arnold's mind after he was thrown out, lest the man's feet hould have injured the fabric of the envelope. As a matter of act no harm had been done, and it is evident that Arnold's anticipaion that ' the upper part of the Balloon would necessarily become a Parachute, and . . . would not descend so rapid, as to endanger his [son's] life ', proved correct. Thus although this first attempt o exhibit the possibility of using a parachute in order to descend rom a free balloon was a fiasco, the principle of ' parachuting ' he balloon itself was unwittingly demonstrated, and the boy's life saved thereby.[1] But the affair proved the end of Arnold's aeronautical ventures, for though some days later he issued a public appeal for subscriptions towards the repair of his balloon and the making of a new parachute, nothing further was done.[2]

Other ascents made in England during these early years may be more briefly recorded, their interest being rather a matter of date than remarkable as ballooning exploits, though it should be added that for the most part the existing records are scanty. The first ascent from Birmingham was achieved by Harper, in the balloon purchased from James Sadler. From an amusing contemporary account of Harper's aeronautical exploits, written in satirical verse and published at Birmingham under the title of

Harper's Ascent from Birmingham, Jan. 4, 1785.

[1] In later times Charles Green, John Wise (the American aeronaut), Coxwell, and others realized that it was feasible to use the balloon as a parachute in case of an accident. (See Fig. 68). The method of doing so is described by Griffith Brewer in his lectures (delivered at Roehampton during the Great War) on the *Theory of Ballooning*, 1918.

[2] The damaged balloon, ' with the remaining carrier pigeon preserved from drowning ', was subsequently exhibited at the Rotunda, St. George's Fields.

'The Ballooniad, in two Cantos', it appears he was a barber, though the author is clearly puzzled as to how his hero (characterized under the name of 'Strap') became interested in balloons.

> When thy great hands the menial bason bore
> What first induc'd the love of chemic lore?
> Did soapy bubbles Air Balloons supply
> And teach thy soaring mind to mount the sky? [1]

A first attempt apparently ended in failure, but on January 4, 1785, despite fog and a heavy downpour of rain—which failed to disperse the large crowd assembled—Harper ascended from the Tennis Court and was out of sight with 'prodigious swiftness'. After an uneventful flight of 70 miles, during which the balloon rose to 4,300 feet—an elevation sufficient to afford the aeronaut the enjoyment of unlooked-for and uninterrupted sunshine—a safe landing was made at Millstone Green, near Newcastle in Staffordshire. Encouraged by his triumphant success Harper tried another flight on January 31st, but

> Alas! how soon thy tow'ring hopes were quash'd
> And thy grand bubble 'gainst vile chimnies bash'd.

For the balloon failing to clear the house-tops Harper had to escape ignominiously through a chamber window, leaving in the car as ballast a small boy, who thereupon experienced the alarming sensation of being whisked off alone, but who soon came to earth without harm owing to a rent in the envelope.[2]

Routh's Ascent at Beccles, Oct 1785.

Early in October 1785 a balloon constructed by the Rev. Peter Routh ascended from Beccles, with two other occupants in the car, one of whom was a lady named Hines. Rising to a great height the balloon was driven out to sea in the neighbourhood of Yarmouth, and owing to the high wind it was thought the aeronauts must inevitably be lost. Next day, however, news arrived that a Dutch vessel had rescued them off the coast of Holland, the balloon helping to sustain the car which floated on the water, and on

[1] The writer has seen only one representation of Harper's balloon (from the car of which projects an oar similar to those used by Lunardi), and this appears on a ladies vanity or patch box (Fig. 68). Made of china, with a mirror in the lid, it serves as a fitting souvenir of the ballooning exploits of a hairdresser. [The Tissandier Collection contains several similar specimens.] Moreover the writer is aware of only one copy of the rare pamphlet above mentioned—kindly lent him by Dr. F. J. Poynton. It is the second edition, and has an additional Third Canto which describes the failure on Jan. 31.

[2] *European and Town and Country Magazines*, January 1785. Cf. Monck Mason, p. 289.

October 7th they returned to Beccles amidst the acclamations of thousands of spectators.[1] On November 22, 1784, a 'balloon of great magnitude', made jointly by a Monsieur Raphine and an Englishman named Cousins—the latter said to have been a 'gentleman of great scientific knowledge'—ascended from Brentford, and after an hour's flight a landing was made near Dorking in Surrey, a distance of twenty-one miles. The inflation of this balloon was not effected in the way then usual, viz. by hydrogen obtained from zinc or iron filings and vitriolic acid—but 'from less expensive materials', the nature of which was not reported, though it was hoped the method would prove an important discovery in the history of aerostation.[2] Of such other ascents as are recorded nothing is known save mere names and dates—for instance, Binn, Frobisher, and Newmarck from Halifax on August 9, 1785, and Poole from Bury on October 15th of the same year. After 1785 very few balloon ascents were made in England, doubtless partly owing to the cumulative discouragement of failures; the discouragement resulting from the inability to make any advance in the way of directing balloons, and also, possibly, to the fact that amongst the masses the novelty had to some extent worn off. Even Sadler gave up what had become to him a profession, and did not resume it actively until 1810. Amongst the few exceptions was the successful exploit of Lallement de Saint-Croix, who ascended on June 19, 1786, from the Castle Yard, Exeter—an event witnessed by great crowds, and duly recorded as 'the grandest spectacle ever seen in England'. The ascent was made in very fine weather, and the balloon having reached an elevation—it is said—of not less than three miles, Saint-Croix landed safely in Cornwall.[3] But the decline in ballooning activities during the last few years of the century is clearly revealed in the fact that after 1786 no British ascents appear in the list of early aeronauts as printed in Hatton Turnor's *Astra Castra* until 1802, when Sowden, Locker, and Glasford went up with Garnerin.[4]

Raphine's Ascent at Brentford, Nov 22, 1784

Saint-Croix's Ascent at Exeter, June 19, 1786.

[1] Monck Mason gives the date as Oct. 11 (p. 273).

[2] See Monck Mason, p. 288.

[3] The usual exhibition of the balloon is recorded to have produced the substantial sum of £150. Saint-Croix also ascended from Salisbury on Aug. 10 and Sept. 17 following (see Monck Mason, p. 276). A memoir by him, dated 1790–1 and now in the Musée Carnavalet, Paris, gives an account of his ascents in England, also the assistance he gave Blanchard, his ascent with Garnerin from Paris in Aug. 1791, &c.

[4] Op. cit., pp. 457–62. Hatton Turnor's list is in the main copied (not quite accurately) from the revised one in Dupuis-Delcourt (pp. 222–39) and from Monck Mason (pp. 246–90).

CHAPTER IX

THE BALLOON IN LITERATURE, CARICATURE, AND FASHION

Public Interest in the Invention of the Balloon.

It is probable that the balloon excited at the moment of its inception, and for years after, a more universal interest than any other invention which the ingenuity of man has devised. The reasons are apparent. The hitherto unheard of sight of a seemingly ponderous body ascending into the air, was in itself a sufficient marvel; indeed, it cannot be denied that to this day the perfectly noiseless and effortless motion of a balloon moving through the air is an attractive spectacle. Even Otto Lilienthal admitted (when writing—about 1890—of the balloon as an obstacle to flight) that it 'must have been intoxicating when, a century ago, the first man actually rose from the earth into the air'. Again, the fact that the balloon lent itself in a unique way to spectacular display, that its ascent could be witnessed (mostly without payment) by immense crowds, that in early days the balloons themselves were made of gaily coloured silks with elaborately decorated cars, and that the allurement of possible disaster was ever present—these aspects afforded further attraction to the masses. Incidentally it may be noted that in England as abroad, failure to achieve an ascent invariably excited those unreasoning passions of destructive revenge, which spring from intense disappointment and the feeling of having been cheated.[1]

At the outset, that is to say, after the first experiments in Paris in 1783, the 'balloon craze' in this country showed itself chiefly in the widely fashionable amusement of sending up toy balloons, mostly of the 'Montgolfière' type.[2] Later, when it was realized that the invention of the balloon enabled man to travel through the air from place to place, the subject became one for more serious consideration. Speaking generally, opinion in England, as in France, was unequally divided—on the one hand the more enlightened and far-seeing realized in this long-sought achieve-

[1] Cf. Raleigh (W.) *The War in the Air*, vol. 1, 1922, p. 78.

[2] The demand for these small balloons—both 'Montgolfières' and 'Charlières'—was so great that several London tradesmen made a speciality of them. See note 2 on p. 185, *ante*.

FIG. 62. English Caricature of Montgolfier's Invention of the Balloon, 1783.

FIG 63 Caricature by R Seymour, depicting Lennox's 'Eagle' Attacked in Mid-air, 1835

ment possibilities which gave rise to hopes of utility in the service of man; on the other, those (including the unthinking majority) who derided the futility of the whole idea, jeered at attempts, and ridiculed failure. The contemporary press of the day affords evidence of extreme views in both directions; enthusiastic supporters of the invention formed extravagant and unfounded hopes—destined for nearly a century to be unattainable—while the sceptical sought to discredit the balloon by ridicule expressed in prose and verse, as well as in pictorial caricature. To an enthusiastic 'advocate of all new discoveries' this art of travelling through the air, above the clouds, appeared as 'infinitely the most magnificent and most astonishing discovery made . . . perhaps since the creation'.[1] To the cynic it seemed merely an object deserving 'the attention of all men to laugh this new folly out of practice as soon as possible'.[2] The more detached critic was content to point out with the impartiality of one averse from argument and strife, that 'if, after all, the Pursuit ends in Air (as is possible), we shall at least come at some new fact that shall tell us why it does so, the employment in the mean Time being more innocent than cutting each others throats for absurd Trifles by Sea and Land'. A smaller section took the view that any attempt at flight was immoral; that had Providence decreed man should fly, he would have provided him with natural means, and recognized in such accidents as overtook Pilâtre de Rozier, the disapproving judgment of God passed upon the over-weening presumption of man.

Dr. Johnson (1709–84).

To turn from general to individual expressions of opinion, it is probable that the commonsense view of the average Englishman was reflected in the attitude of Dr. Johnson, who lived just long enough to see his forecast in *Rasselas* become in some measure an accomplished fact. His earliest reference to ballooning is apparently to be found in reply to an inquiry from Mrs. Thrale. 'Happy are you', he says, writing from London on September 22, 1783, 'that have ease and leisure to want intelligence of air-balloons. Their existence is I believe indubitable, but I know not that they can possibly be of any use'.[3] Doubtless even at this early date

[1] *Gentleman's Mag.*, November 1788.

[2] *Morning Herald*, Dec. 27, 1783.

[3] See Birkbeck Hill's editions of Boswell's *Life* and Johnson's *Letters*. Some years later Mrs. Piozzi was moved to write a 'Sonnet on an Air Balloon' (from an old Magazine, February 1788).

Johnson fully realized that balloons were at the mercy of the winds, and must be, so to speak,

> . . . blown, with restless violence round about
> The pendent world,

unless some means could be found for directing them. A year's experience of balloon ventures confirmed this opinion, for writing to his friend Dr. Brocklesby on the subject—a 'species of amusement', as he terms it—he adds that 'in amusement, mere amusement, I am afraid it must end, for I do not find that its course can be directed, so as that it should serve any purposes of communication'.[1] But there is reason to believe that Johnson's interest in ballooning was not merely a critical one. Writing to Mrs. Thrale in January 1784 he says, 'You observe, Madam, that the balloon engages all mankind, and it is indeed a wonderful and unexpected addition to human knowledge; but we have a daring projector, who, disdaining the help of fumes and vapours, is making better than Daedalean wings, with which he will master the balloon and its companions as an eagle masters a goose. . . . When I can leave the house, I will tell you more'.[2] Later in the year, replying on August 21st to a letter from Brocklesby, which apparently described some ballooning fiasco in London, Johnson asks, 'Is this the Balloon that has been so long expected, this balloon to which I subscribed but without payment?'[3] It would be interesting to know in what sense Johnson subscribed to the project, for his remark certainly suggests some active concern in it. It would be interesting also to know how Johnson became so far interested in the first English aeronaut, James Sadler, as to present him with a barometer. Possibly he came to know of Sadler through William Windham, who was not only one of Johnson's warmest friends and admirers, and a member of 'The Literary Club'—as indeed were Sir Joseph Banks, Dr. George Fordyce, and Sir William Forbes, all of them interested in aerostation—but one whose ardent ballooning enthusiasm led him to make an ascent with Sadler in May 1785.[4]

In any case Johnson's correspondence bears witness to the universality of ballooning as a topic of conversation. 'I boasted',

[1] See Hoole (S.), in Ch. XIII, p. 295, *post*.

[2] Possibly the flying machine to which Johnson refers was the project described in *The Air Balloon*, 1783, p. 34.

[3] Brocklesby may have described Moret's failure at Chelsea on Aug. 10, though Sheldon's project with Keegan seems a more likely object of Johnson's support.

[4] See *ante*, Ch. VI, pp. 145

he writes in December 1783, 'that I had passed the day with three friends, and that no mention had been made among any of us of the air ballon (*sic*), which has taken full possession, with a very good claim, of every philosophical mind and mouth', while a year later, when writing to Sir Joshua Reynolds (a few days after Lunardi's first ascent) he relates that he had received 'three letters this day all about the balloon'. 'I could', he adds, 'have been content with one. Do not write about the balloon, whatever else you may think proper to say.' A week or so later he refers to the burning of Keegan's balloon, which he did not much lament, for while he admitted that the first experiment was bold and deserved applause and reward, having been performed, he would rather learn of the discovery of a cure for asthma. Curiously enough Johnson's reference to asthma—from which he was then suffering so acutely—had been forestalled in the small treatise on *The Air Balloon*, the writer of which had suggested that one of the practical uses of the balloon would be the possibility of affording what physicians call 'a change of air', to those suffering from 'asthmas and decays'. A little less than two months later—on November 17, 1784—Johnson makes his last reference to balloons in a letter to his old friend, Hector of Birmingham, when he records a final visit to Oxford, and tells how he sent his faithful servant Francis 'to see the balloon fly'.[1] The concluding phrase, 'but could not go myself', has an evident touch of regret, sufficient at least to suggest that Johnson's insatiable interest in all human activities was not dimmed even at this late hour of his life, though, as he himself was sufficiently aware, he lived to see almost all the free balloon was capable of.

Horace Walpole (1717–97).

Johnson's more cynical, though always shrewdly observant and amusing contemporary, Horace Walpole, viewed ballooning in his own characteristic way. Writing to Sir Horace Mann in Florence on December 2, 1783 (doubtless after hearing of the early ascents in Paris), he passes from the political news of the day to refer in terms of detached contempt, to the universal topic of conversation.[2]

'Do not wonder', he says, 'that we do not entirely attend to the things of earth: fashion has ascended to a higher element. All our views are directed

[1] Birkbeck Hill's edition of Boswell, vol. iv, p. 378. This was the ascent of Jas. Sadler from the Physic Garden, Nov. 12, 1784.

[2] Mrs. Barbauld also bears witness to the interest excited. In a letter written a month later she says that 'next to the Balloon, Miss Burney is the object of curiosity'. Madame D'Arblay herself records in her *Diary* (in this same month) that she caught her 'death almost by looking at [an air-balloon] . . . which went to Bristol in an hour from hence'.

to the air. *Balloons* occupy senators, philosophers, ladies, everybody. France gave us the *ton*; and, as yet, we have not come up to our model. Their monarch is so struck with the heroism of two of his subjects who adventured their persons in two of these new *floating batteries*, that he has ordered statues of them, and contributed a vast sum towards their marble immortality. All this may be very important: to me it looks somewhat foolish.' [1]

Evidently he had little faith in the invention—

'the former Icarus broke his neck at a subsequent flight: when a similar accident happens to modern knights-errant, adieu to air-balloons'.

Even if they did succeed he feared, as indeed Lana had done in the seventeenth century, that they would be used (as the Great War proved only too conclusively that they could be used) for military purposes, for the same letter closes with these prophetic sentences:

'Well! I hope these new mechanic meteors will prove only playthings for the learned and the idle, and not be converted into new engines of destruction to the human race, as is so often the case of refinements or discoveries in science. *The wicked wit of man always studies to apply the result of talents to enslaving, destroying, or cheating his fellow creatures.* Could we reach the moon, we should think of reducing it to a province of some European kingdom.' [2]

Holding these views it is not surprising that Walpole did not bother his head about these 'new kites', as he contemptuously termed them, and it was not until the end of June 1784 that he even saw an air-balloon. Writing to Conway from Strawberry Hill on June 30th of that year, he gives an amusing account of his first sight of one—

'I have, at last, seen an air-balloon; just as I once did see a tiny review, by passing one accidently on Hounslow Heath. I was going last night to Lady Onslow at Richmond, and over Mr. Cambridge's field I saw a bundle in the air not bigger than the moon, and she herself could not have descended with more composure if she had expected to find Endymion fast asleep. It seemed to 'light on Richmond Hill; but Mrs. Hobart was going by, and her *coiffure* prevented my seeing it alight. The papers say that a balloon has been made at Paris representing the Castle of Stockholm, in compliment to the King of Sweden; but that they are afraid to let it off; so, I suppose,

[1] The quotations are from Mrs. Paget Toynbee's edition of Horace Walpole's *Letters*, Oxford, 1905, vol. xiii. The notes there given on ballooning incidents are not quite accurate.

[2] Bishop Wilkins (in *The Discovery of a New World*, p. 115) quotes Kepler's opinion that as soon as the 'Art of Flying' is invented, his countrymen would be the first to transplant colonies to the moon.

FIG 64 CARICATURE ON BALLOONING BY THOMAS ROWLANDSON, 1811

it will be served up to him in a dessert. No great progress, surely, is made in these airy navigations, if they are still afraid of risking the necks of two or three subjects for the entertainment of a visiting sovereign. There is seldom a *feu de joie* for the birth of a Dauphin that does not cost more lives. I thought royalty and science never haggled about the value of blood when experiments are in the question.'

In that attitude he persisted, though (inconsistently and apparently against his own intentions) he allowed the subject to encroach on his letters.

'I cannot fill my paper', he writes to Sir Horace Mann in September 1784, 'as they [the newspapers] do with air-balloons; which, though ranked with the invention of navigation, appear to me as childish as the flying kites of school-boys. I have not stirred a step to see one; consequently, have not paid a guinea for gazing at one, which I might have seen by only looking up into the air. An Italian, one Lunardi, is the first *airgonaut* that has mounted in to the clouds in this country. So far from respecting him as a Jason, I was very angry with him: he had full right to venture his own neck, but none to risk the poor cat, who, not having proved a martyr, is at least better entitled to be a confessor than her master Daedalus. I was even disappointed *after* his expedition had been prosperous: you must know, I have no ideas of space: when I heard how wonderfully he had soared, I concluded he had arrived within a stone's throw of the moon—alas! he had not ascended above a mile and a half: so pitiful an ascension degraded him totally in my conceit. As there are mountains twice as high, what signifies flying, if you do not rise above the top of the earth? Any one on foot may walk higher than this man-eagle! Well! now you know all that I know—and was it worth telling?'

But Walpole could not altogether escape, even if he would, from the balloon craze, and the following extract from a letter written to Conway in October of the same year, shows that he surrendered to the fascination which had infected even his servants.

'As I was writing this', he tells Conway, 'my servants called me away to see a balloon; I suppose Blanchard's, that was to be let off from Chelsea this morning. I saw it from the common field before the window of my round tower. It appeared about a third of the size of the moon, or less, when setting, something above the tops of the trees on the level horizon. It was then descending; and, after rising and declining a little, it sunk slowly behind the trees, I should think about or beyond Sunbury, at 5 minutes after one.' [1]

He then proceeds in a delightfully fanciful vein to picture his own reverie on aerial navigation, which reads like the germ of Kipling's

[1] This was Blanchard's ascent from Chelsea, Oct. 16, 1784. See Ch. VII, p. 162.

'Night Mail'. and must surely be the first prophetic and imaginative report of 'Air-mail Intelligence'.

'Only t'other night I diverted myself with a sort of meditation on future *airgonation*, supposing that it will not only be perfected, but will depose navigation. I did not finish it, because I am not skilled, like the gentleman that used to write political ship-news, in that style which I wanted to perfect my essay: but in the prelude I observed how ignorant the ancients were in supposing Icarus melted the wax of his wings by too near access to the sun, whereas he would have been frozen to death before he made the first post on that road. Next, I discovered an alliance between Bishop Wilkins's art of flying and his plan of an universal language; the latter of which he no doubt calculated to prevent the want of an interpreter when he should arrive at the moon.[1] But I chiefly amused myself with ideas of the change that would be made in the world by the substitution of balloons to ships. I supposed our sea-ports to become *deserted villages*; and Salisbury Plain, Newmarket Heath (another canvass for alteration of ideas), and all downs (but *the* Downs) arising into Dockyards for aerial vessels. Such a field, would be ample in furnishing new speculations. But to come to my ship-news:—

> "The good balloon Daedalus, Captain Wing-ate, will fly in a few days for China; he will stop at the top of the Monument to take in passengers. Arrived on Brand Sands, the Vulture, Captain Nabob; the Tortoise snow, from Lapland; the Pet-en-l'air, from Versailles; the Dreadnought, from Mount Etna, Sir W. Hamilton, commander; the Tympany, Montgolfier; and the Mine-A-in-a-bandbox, from the Cape of Good Hope. Foundered in a hurricane, the Bird of Paradise, from Mount Ararat. The Bubble, Sheldon, took fire and was burnt to her gallery; and the Phoenix is to be cut down to a second-rate." '[2]

'In those days!' he concludes, 'Old Sarum will again be a town and have houses in it. There will be fights in the air with wind-guns and bows and arrows; and there will be prodigious increase of land for tillage, especially in France, by breaking up all public roads as useless. But enough of my fooleries, for which I am sorry you must pay double postage.'

Early in the following year, the successful Channel crossing by Blanchard and Jeffries on January, 7, 1785, called forth further reflections from Walpole, in a letter to the Countess of Ossory.

'You see', he writes, 'the airgonauts have passed the Rubicon. By their own account they were exactly birds; they flew through the air, perched

[1] Walpole's satirical reference is to Bishop Wilkins's *Essay towards a real Character and a Philosophical Language*, 1668.

[2] The names are most topical allusions, e. g. Sir W. Hamilton was at this time plenipotentiary at Naples; Mine-A-in-a-Band-box is a reference to the character of Mine-all in F. Pilon's farce *Aerostation*, produced at Covent Garden on Oct. 29, 1784. The Bubble refers to Keegan's balloon with which Sheldon was connected. See Ch. IV, p. 113.

on the top of a tree, some passengers climbed up and took them in their nest. The smugglers, I suppose, will be the first who will improve on the plan. However, if the project is ever brought to any perfection (though I apprehend it will be addled, like the ship that was to live under water, and never came up again), it will have a different fate from other discoveries, whose inventors are not known. In this age, all that is done (as well as what is never done) is so faithfully recorded that every improvement will be registered chronologically. Mr. Blanchard's trip to Calais puts me in mind of Dryden's Indian emperor :

> What divine monsters, O ye Gods, are these,
> That float in air, and fly upon the seas !

Dryden little thought that he was prophetically describing something more exactly than ships as conceived by Mexicans. If there is no air-sickness, and I were to go to Paris again, I would prefer a balloon to the packet-boat, and had as lief roost in an oak as sleep in a French inn, though I were to caw for my breakfast like the young ravens.'

That the subject of balloons continued as late as May 1785 to excite keen interest is revealed in a letter wherein Walpole informs Sir Horace Mann that ' of conversation, the chief topic is air-balloons ', as to which—no fatal accidents having happened up to this date—he expresses the entirely negative opinion that, ' neither good nor harm has hitherto been produced by these aerial enterprises '. But Walpole had evidently come to regard aerostation a little more seriously, and we find him—at his housekeeper's suggestion—condescending to go out into the garden at Strawberry Hill in order to see the balloon in which Sadler and Windham ascended from Molesey Hurst on May 5, 1785. Relating the incident, he tells how

' Mr. Windham, and Sadler his pilot, were near meeting the fate of Icarus ; and though they did land safely, their bladder-vessel flew away again, and may be drowned in the moon for what we know ! ' ' Three more balloons ', he adds, ' sailed to-day ; in short, we shall have a prodigious navy in the air, and then what signifies having lost the empire of the ocean ? '

A final quotation shows that Walpole was now nearly approaching that mental attitude commonly known as ' sitting on the fence '.

' How posterity will laugh at us ', he writes in June 1785, ' one way or other ! If half-a-dozen break their necks, and balloonism is exploded, we shall be called fools for having imagined it could be brought to use : if it should be turned to account, we shall be ridiculed for having doubted.'

William Cowper (1731–1800)

The impressions of another accomplished letter-writer, William Cowper, the poet, are admirably conveyed in a letter to his friend John Newton. Writing in December 1783 he gives expression (at unexpected length) to his ideas on the subject.

'I know not', he writes, 'how it fares with you at a time when philosophy has just brought forth her most extraordinary production, not excepting, perhaps, that prodigy, a ship, in all respects complete, and equal to the task of circumnavigating the globe. My mind, however, is frequently getting into these balloons, and is busy in multiplying speculations as airy as the regions through which they pass. The last account from France, which seems so well authenticated, has changed my jocularity upon this occasion into serious expectation. The invention of these new vehicles is yet in its infancy, yet already they seem to have attained a degree of perfection which navigation did not reach, till ages of experience had matured it, and science had exhausted both her industry and her skill, in its improvement. I am aware, indeed, that the first boat or canoe that was ever formed, though rude in its construction—perhaps not constructed at all . . . was a more perfect creature in its kind than a balloon at present; the single circumstance of its manageable nature giving it a clear superiority both in respect of safety and convenience. But the atmosphere, though a much thinner medium, we well know, resists the impression made upon it by the tail of a bird, as effectually as the water that of a ship's rudder. Pope, when inculcating one of his few useful lessons, and directing mankind to the providence of God as the true source of all their wisdom, says beautifully—

> Learn of the little nautilus to sail,
> Spread the thin oar, and catch the driving gale.

It is easy to parody these lines, so as to give them an accommodation and suitableness to the present purpose.

> Learn of the circle-making kite to fly
> Spread the fan-tail, and wheel about the sky.

It is certain, at least, that nothing within the reach of human ingenuity, will be left unattempted to accomplish, and add all that is wanting to this last effort of philosophical contrivance . . . especially possessed as we are of such consummate mechanical skill, already masters of principles which we have nothing to do but to apply, of which we have already availed ourselves in the similar case of navigation, and having in every fowl of the air a pattern, which now at length it may be sufficient to imitate. Wings and a tail, indeed, were of little use, while the body, so much heavier than the space of air it occupied, was sure to sink by its own weight, and could never be held in equipoise by any implements of the kind which human strength could manage. But now we float; at random, indeed, pretty much, and as the wind drives us; for want of nothing, however, but the steerage which invention, the conqueror of many equal, if not superior difficulties, may be expected

to supply. Should the point be carried, and man at last become as familiar with the air as he has long been with the ocean, will it in its consequences prove a mercy, or a judgment? I think, a judgment. First, because if a power to convey himself from place to place, like a bird, would have been good for him, his Maker would have formed him with such a capacity. But he has been a groveller upon the earth for six thousand years, and now at last, when the close of this present state of things approaches, begins to exalt himself above it. So much the worse for *him*. Like a truant school-boy, he breaks his bounds, and will have reason to repent of his presumption. Secondly, I think it will prove a judgment, because, with the exercise of very little foresight, it is easy to prognosticate a thousand evils which the project must necessarily bring after it; amounting at last to the confusion of all order, the annihilation of all authority, with dangers both to property and person, and impunity to the offenders. Were I an absolute legislator, I would, therefore, make it death for a man to be convicted of flying, the moment he could be caught; and to bring him down from his altitude by a bullet sent through his head or his carriage, should be no murder. Philosophers would call me a Vandal; the scholar would say that, had it not been for me, the fable of Daedalus would have been realised; and historians would load my memory with reproaches of phlegm, and stupidity, and oppression; but in the mean time the world would go on quietly, and if it enjoyed less liberty, would at least be more secure.' [1]

Unlike his more frivolous contemporary Walpole, Cowper, though he gave expression to these disparaging comments, took advantage of the first opportunity to see an air-balloon at Weston, near Olney, in May 1784, but though 'the whole country were there', the inflation proved a failure. In August the same year the poet himself took part in the 'philosophical experiment' of sending up a balloon from Emberton Meadows. 'Thrice it rose', he writes in a letter to Newton, describing the affair, 'and as oft descended; and in the evening it performed another flight at Newport, where it went up, and came down no more. Like the arrow discharged at the pigeon in the Trojan games, it kindled in the air, and was consumed in a moment.' At a later date (in a letter to Unwin) Cowper wrote that he had 'read Lunardi with pleasure', while early in the year following he was interested in Blanchard's account of the Channel crossing. 'I have been crossing the Channel in a balloon', he says, 'ever since I read of that

[1] *Correspondence of Wm. Cowper*, arranged by T. Wright, vol. ii, 1904, pp. 132 et seq. In an earlier letter to Rev. W. Unwin, Cooper declared that he was 'quite charmed with the discovery', and then proceeds to indulge in quaint suggestions as to the possibility of applying the aerostatic principle to man himself. For similar notions of the kind see Bruel, nos. 17–20 (*L'Homme Aérostatique*, &c.).

achievement by Blanchard. I have an insatiable thirst to know the philosophical reason, why his vehicle had liked to have fallen into the sea, when, for aught that appears, the gas was not at all exhausted. Did not the extreme cold condense the inflammable air, and cause the globe to collapse? Tell me, and be my Apollo for ever!' It is doubtful whether the poet received any god-like answer to his inquiry, for the simple principle which governs the alternate rise and fall of the balloon was not fully understood in those early days.[1] In any case his interest in balloons is not further evinced in his published correspondence.

The Balloon in Children's Books.

It may be just worth adding that the balloon, doubtless by reason of its appeal to the wonderment and curiosity of the juvenile mind, soon found its way into the pages of contemporary books for children. At the outset the balloon, as an attractive object floating harmlessly and placidly in the air, failed to lend itself to the infusion of that moral or 'unflinchingly didactic' tone, then prevailing in little volumes of the 'good Mrs. Trimmer' type of authorship. For example, the author of *Moral Tales in Verse*—a typical if forbidding title—sought to 'please and instruct' the young by describing the 'Sights of the Air', with the obvious intention of 'introducing' a balloon:

> But when a Balloon, with a *man* at its tail,
> Like a black little speck can be seen
> By the aid of a glass, should the naked eye fail,
> Curiosity then is extreme!

Though these buoyant lines may, perchance, faintly recall the excitement enjoyed by a child at a balloon ascent, they wholly fail to bear the burden of the irrelevant moral tag in the concluding verses. As time progressed moralizing on the subject tended to emphasize the danger and futility of balloons, and in so doing reflected adult opinion. For instance, in utilizing the invention—with the help of coloured woodcuts—as a *New and Easy Method of teaching the Alphabet*, the purpose is only achieved towards the close by dragging in the Unaccustomed character of such Ventures, the doubtful Wisdome of these lofty journeys, and the strained reflection that Xerxes himself was surely less Zealous to ascend so high—an exercise of ingenuity which must have surely proved

[1] Cavallo (pp. 187–8) rightly controverted the idea that the sea (as was suggested) had any attractive power, but his own explanation was not wholly correct.

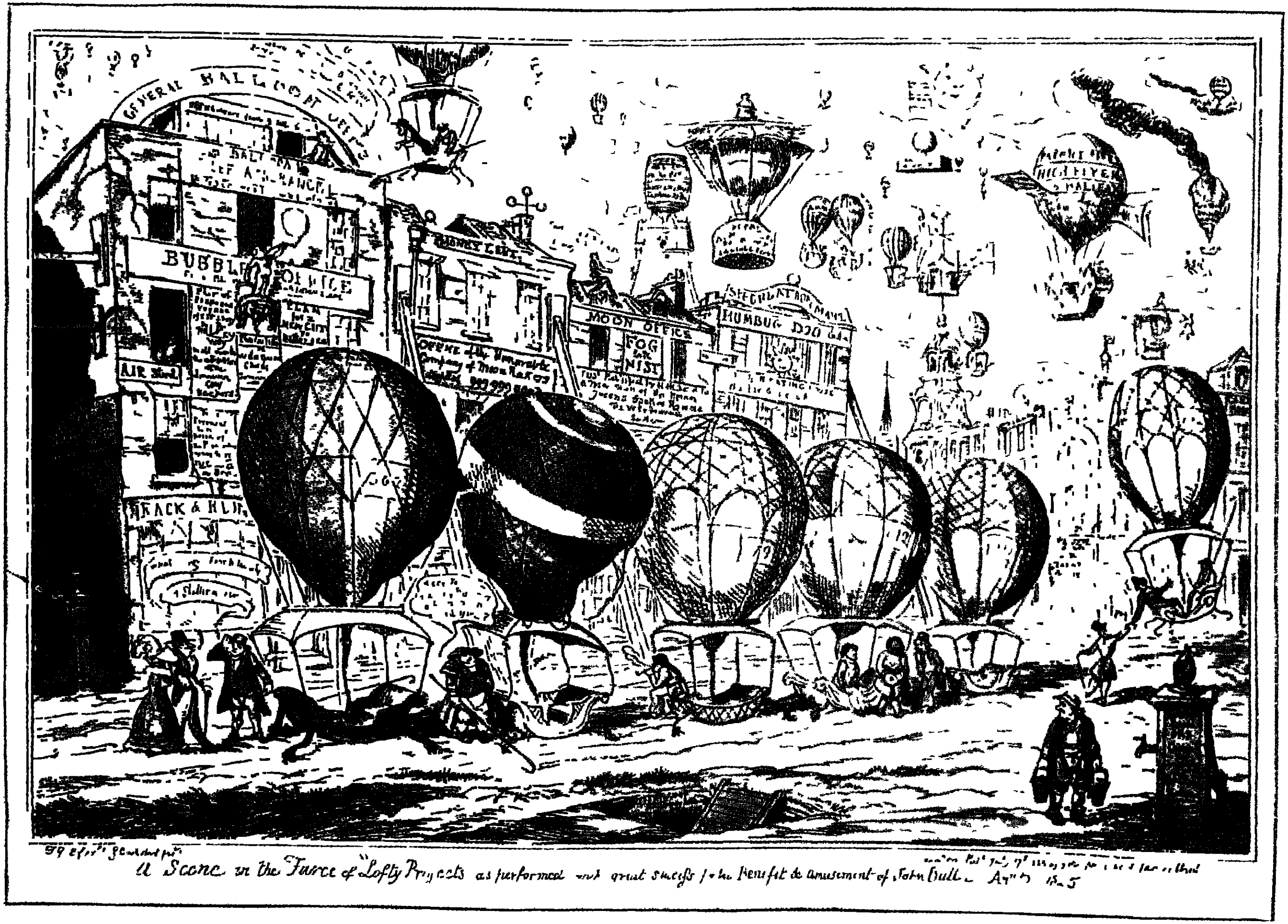


Fig. 65. CARICATURE ON BALLOON PROJECTS BY GEORGE CRUIKSHANK

1825

sad stumbling-block to young learners. Mary Elliott, a popular 'riter of tales and of descriptive sketches for children between 810 and 1820, thus meditates, with a deplorable lack of aero-autical enthusiasm, on ' Filling a Balloon ' :

I imagine we should not like to exchange situations with the bold adven-ırers who mean to journey through the air like birds ; for, though we allow ıey possess courage . . . there is always danger in such trials. The balloon ıay burst, or take fire, and then the travellers have a poor chance for their ves. Thus we are much safer as lookers on . . . and, as balloons are of no ertain use, nor ever were the means of making any sort of discovery, we shall ot direct our genius to that line, or spend our money in so vain a pursuit.'

But though the balloon was often treated with disparagement— , was contemptuously dismissed by another mentor of youth as f less ' sensible utility ' than ' one gasburner '—it was frequently escribed, with little regard for accuracy, in such small books as *ectures at my School*, 1810. Here the balloon is described as a Large ball made of silk, and being filled with air, or some com-ustible, it will mount up, assisted by the air, to a great height '. r it was more jauntily pictured in verse, as in the *Parent's 'oetical Present*:

The *balloon*, my dear boy, is of silk closely wrought
In a conical shape as you see ;
The *car* is of very light wicker-work, fraught
With sand, that it steady may be.

. . . .

The *balloon's* filled with *gas*—that is, vapour made *rare*,
Which forces its way to the top ;
And its lightness impels it to pass through the air,
And, indeed, it scarce ever would stop,

Were it not that they have, at the top, a valve plac'd
Which they open and shut at their ease,
By the aid of a string ; they thus check their haste,
Rise and fall, fast or slow, as they please.

Both balloons and parachutes figure also in the juvenile dice ames and toy books of the early part of last century. An amusing xample of the latter appeared in Walker's *Theatre of Fancy, or 'uvenile Scenic Representations*, 1810, as *The Grand Air Balloon, r Harlequin Aeronaut*, which, in a series of pictures with turn-up laps—' Sixpence coloured—Threepence plain '—tells the story of ıarlequin and columbine who elope in a balloon. Chased by an rate parent in another balloon they descend together in a parachute

—a daring achievement then almost unknown in England and one for which the artist must have relied on Garnerin's exploit in 1802.

The Balloon in Poetry.

Passing from such trifles to the more serious realms of poetry, it cannot be said that the invention of the balloon proved an inspiring theme, for though—in England, as on the Continent—it was the subject of numerous poetical effusions, few of them are of literary interest or merit.[1] Probably the earliest lines written in this country were the Latin verses, which, under the title of 'Aerostatica', won for Charles Abbot, afterwards Lord Tenterden, the Chancellor's medal at Oxford in 1784. Of greater interest are the lines entitled 'Aerophorion', written 'on seeing Mr. Sadler, the first English aeronaut, ascend in his balloon from the Physic Garden in Oxford, in November, 1784', by Henry James Pye, whose poetry—he was the laureate for about twenty-three years—is wholly forgotten, and who is himself remembered, if he ever is remembered, simply as the arch-butt of anti-laureate jokes.[2] Though it has been truly said of Pye that he was 'not so much a bad poet as no poet at all', it may be claimed that his verses on Sadler rise above the average level of his utterly insipid official poetry. Opening with an apostrophe to those who, borne aloft by ambition and the 'love of manly enterprise', leave the beaten paths of life to the indolent and fearful, he justly stigmatized the commonly prevalent view of those who mocked at inventions which they lacked imagination to grasp,

> And damn the Scheme, whose Author can't produce
> The exact returns of profit and of use.

—a couplet recalling in vigour and directness the satires of Dryden or of Pope. If the subsequent description of the aeronaut's experience in aerial flight is empty rhetoric, at least Pye had sufficient imagination to conceive one situation—the possibility of ascending above the region of a depression—of import in aeronautical travel, whereby the pilot in

> . . . proudly rising o'er the lagging wind
> Leaves all the jarring Atmosphere behind,
> And at his feet, while spreading clouds extend,
> While Thunders bellow, and while storms descend,
> Feels on his head the enlivening sunbeams play,
> And drinks in skies serene the unsullied beams of day.[2]

[1] Cf. Boffito, ch. xxi, *Litteratura Aerostatica*.

[2] Deeker was one of the first to experience such conditions. See the account of his ascent from Norwich in June 1785, in Ch. VIII, p. 185. A recent and more significant

In the concluding lines Pye returns to address the 'gloomy cynics' who, despising this newly invented form of scientific discovery,

> Yet Hell's remotest regions would explore,
> If the rich mine allured with proffer'd ore.

and, in a couplet pregnant with meaning, invites them to

> Say can ye tell what this, yet novel art,
> May to the future race of man impart?

a question to which even now no adequate answer can be given.[1]

The poem in which Erasmus Darwin—whose verses, though now never read, pleased both Walpole and Cowper—described Montgolfier's flight in a balloon, certainly excels Pye in 'rhetorical extravagance' and 'padding epithet'.[2] To Darwin Montgolfier's balloon is at one time 'the vast concave of his buoyant ball' and at another the 'silken castle' which glides,

> Bright as a meteor through the azure tides;
> O'er towns, and towers, and temples wins its way,
> Or mounts sublime, and gilds the vault of day.

From such meaningless rapture it is a relief to fall to such equally commonplace phrases as,

> Now less and less—and now a speck is seen.

—a line which has at least the merit of expressing the visual experience of the spectator. But Darwin's rhetorical figures—when, for instance, he imagines the 'intrepid Gaul' as he sails aloft and

> Sees at his feet the forky lightnings glow
> And hears innocuous thunders roar below—

are not only characteristic of the monotonous and empty cadence of so much of his 'pompous rhymes', as Byron called them, but,

parallel may be found in the historic flight to America of the airship R. 34, during which the wind and rain of a 'shallow' depression were evaded by climbing to a higher level. See Maitland (Air-Commodore E. M.), *The Log of H.M.A. R. 34* [1921], p. 53.

[1] [Pye (H. J.)] *Aerophorion. A Poem*, Oxford, 1784. Reprinted in *Poems on Various Subjects*, 1787, vol. i, p. 153.

[2] Darwin (E.), *The Botanic Garden*, 3rd ed., 1795, Part 2, Canto II, lines 25–66. See also note as to his verses on the death of Pilâtre de Rozier (p. 161, *n.* 1). In Part 1, Canto I, appear the lines (often quoted as prophetic) on the power of steam to drive.

'The flying-chariot through the fields of air'.

re-echoing the lines by Pye, they may stand as a measure of the 'aerostatic' poetry of the period.

In the great poets of the early period the balloon afforded no more than a passing metaphorical allusion. Burns, for instance, incidentally immortalizes the fleeting vogue of the Lunardi 'balloon bonnet' in the lines, 'To a Louse', while Wordsworth in 'The Blind Highland Boy', inaptly compares the joy the child experiences as he floats on the waters of Loch Laren, to

> The bravest traveller in Balloon,
> Mounting as if to reach the moon.[1]

But the poetasters and wits of the day—as indeed for the next twenty or thirty years—exercised their pens in scribbling verses to 'The Air Balloon', or lines addressed to the intrepid aeronauts, very little of which rises above the merit of doggerel, while much of it is frankly satirical.[2] A typical example was W. H. Ireland's 'rhapsody' addressed 'more particularly to such as have communicated their observations after having experimentally witnessed the effects produced in the atmospheric region', wherein he turns to ridicule the trivial details recorded by the early aeronauts, and the incredibility of some of their experiences:

> Imprimis—I the globe could view,
> Just like a penny ball;
> I dropped from thence (I swear 'tis true)
> A pin, and saw it fall.
>
> . . . .
>
> The forests gooseberry bushes were,
> And rivers skeins of threads;
> The last thing I could note with care
> Were four-score cherries red.[3]

Occasionally a more prophetic note is struck as in the lines by W. R. Spencer, a minor poet and wit, on an air-balloon descending near Harrow. He pictures the sad fate of the coachman and

[1] An allusive metaphor in oratory may be found in Burke's *Reflections on the French Revolution*, 1790, at the close of which, pleading for the preservation of the British Constitution, he adds, 'Let us be satisfied to admire rather than attempt to follow in their desperate flights, the aeronauts of France.'

[2] Doubtless the opinion expressed somewhat later by Anna Seward was commonly held, viz. that since balloons seemed incapable of answering any better purpose than 'that of a raree-show, there cannot be a fitter object of poetic satire'.

[3] Ireland (W. H), *Rhapsodies*, 1803, p. 193. Ireland's literary ability is now forgotten, save for the perverted use he made of it in his notorious Shakespeare forgeries.

FIG 66 CARICATURE OF LENNOX'S 'EAGLE', 1835.
From the cover of a contemporary comic song

postillions if the air supplants the common highways, in so far that

> now the case is alter'd, for, depend on't,
> If flying once comes up, there'll be no end on't,

and he even foresees one of the uses for which the London–Paris air-service has actually been utilized during the last few years :

> Smart milliners shall crowd the air-balloon
> To bring new fashions weekly from the Moon.[1]

Without extending the unprofitable task of reviewing aeronautical references in the poetical literature of subsequent years, there is one poem of a later date which deserves quotation, by reason of its admirably imaginative and prophetic character. Written by Andrew Scott (1757–1839), a labourer of Bowden in Roxburghshire, it appeared in a volume of poems published at Edinburgh in 1826, and took the form of a dialogue between two rustics on rumours current with regard to the building of railways. Expatiating on the wonders of mechanical inventions, Tam agrees with his fellow that future generations will witness still greater marvels, for, he says :

> Wha kens perhaps yet but the warld shall see
> Thae glorious days when folk shall learn to flee ;
> When, by the powers o' steam, to ony where,
> Ships will be biggit that can sail i' the air
> Wi' as great ease as on the waters noo
> They sail, an' carry heavy burdens too.
> What else are thae baloons, contriv'd of late,
> But th'art o' fleeing in its infant state ;[2]
> An' if the warld upon improvements fa',
> The times may come sh'll need nae roads ava ;
> For wha wad creep like snails upo' the yird,
> Gif they might sail the air like ony bird.
> Then might folk eithly visit the abodes
> O' thae far folk they ca' the antipodes,

[1] *The Spirit of the Public Journals*, 1803, p. 357. Perhaps the nadir of aerostatic verse is reached in *The Air Balloon Spiritualized*, by Rev. R. S. Medley, 1823, the quotation of one couplet from which may suffice to substantiate the claim :

> 'I think an Air Balloon quite fairly can,
> Be made an emblem of a wicked man!'

The Aeronaut, 1816, a poem descriptive of Jas. Sadler's ascent from Dublin in 1812, contains one even more atrocious line :

> 'Borne on the gossamer entrails of a worm' . .

[2] The line recalls Benjamin Franklin's well-known retort (quoted on p. 179 *ante*), It may be added that Andrew Scott, after a period of soldiering, settled at Bowden in 1784, and it is possible he saw Lunardi ascend from Kelso (about ten miles away) in 1785.

Or, by the strength o' steam, yet rise aboon,
An' see what kind o' warld there 's i' the moon,
An' aiblins some o' our earth's ferlies gi'e them,
Or try to carry on some traffic wi' them.
At least far continents ayont the sea,
Wad then to ithers like door nei'bours be.
Folks then frae Embro, in a morn, might win in,
To tak' their breakfast wi' their friends in Lonnon,
An' the same ship bring Lonnon folks back in her,
To crack wi' Embro folks an' tak' their dinner.[1]

At a somewhat later period—roughly from 1825 to 1840—when the exploits of Charles Green and the Grahams were attracting immense crowds, the balloon became once more a frequent topic for writers of occasional verse—usually, be it noted, by way of humorous description. Three eminent humorists, Thackeray, Hood, and Barham—amongst a number of journalistic versifiers—tried their hand in this vein. The former contributed to the seventh number of *The Snob* (May 21, 1829) a so-called dramatic sketch entitled *The Veteran Aeronaut, or Mr. Green,* in which at the end of less than a dozen short verses, a ridiculous *dénouement*—the fall of the aeronaut into the Cam—brings the scene to an abrupt close.[2] Barham's effort—'The "Monstre" Balloon', published in *The Ingoldsby Legends*—was a more effectively witty description of the famous voyage to Weilburg in 1837, reflecting public excitement as to the fate of the aeronauts—

Then they talk'd about Green—'Oh! where 's Mister Green?
And where 's Mr. Hollond who hired the machine?
And where is Monck Mason, the man that has been
Up so often before—some twelve times or thirteen—
And who writes such nice letters describing the scene?

the curiosity as to their destination—

Have they got to Grand Cairo or reached Aberdeen?
Or Jerusalem—Hamburg—or Ballyporeen?

[1] Scott (Andrew), *Poems on Various Occasions,* Edinburgh 1826, pp. 42–3.

[2] *The Snob* was a diminutive magazine run by Cambridge undergraduates during May term in 1829. Thackeray is known to have contributed to it, though the above attribution cannot be verified. The prowess of

'Green the Aeronaut, the flying wonder,
The Man who rides on clouds, and darts through thunder . . .
Who threw his ballast out near Hackney Steeple
And nearly blinded all the gazing people',

had been previously used as the *motif* of a political *jeu d'esprit* entitled *High and Low, or Mr. Green among the Stars, Oxford, June 13, 1823,* 1824.

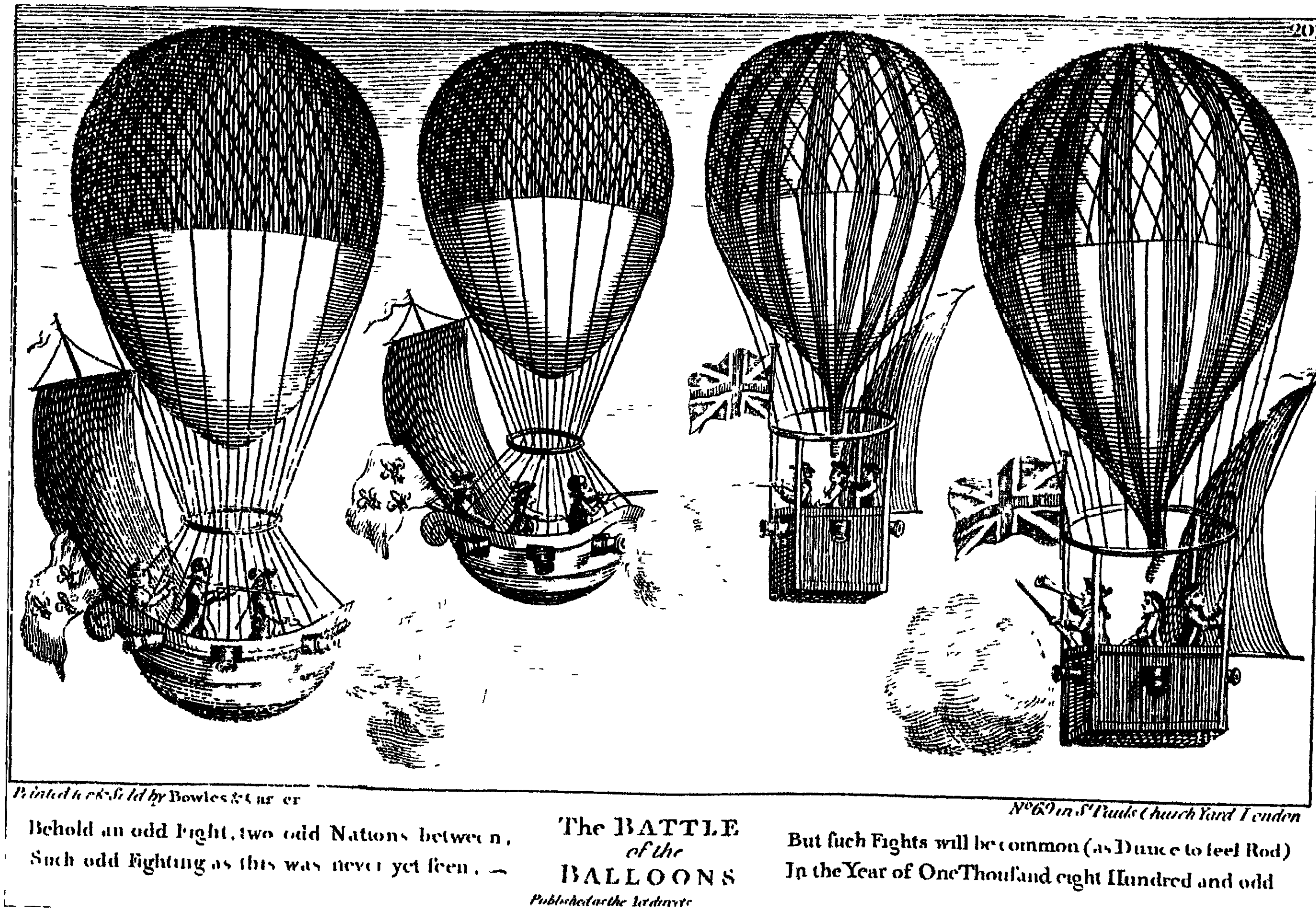


Fig 67 CARICATURE ON AERIAL WARFARE, 1784

and the general feeling of relief as to their safety on the arrival of

> . . . a letter from Hamborough, just come to say
> They descended at Weilburg, about break of day.

Tom Hood's 'Ode to Mr. Graham the Aeronaut'—a poem of thirty-seven verses, more amusing in a literary than in a ballooning sense—describes in a spirit of banter the thoughts which might arise during a balloon voyage. There is no reason to think that Hood had ever 'been up', indeed had he done so he would doubtless have phrased the first sensations a little differently :

> Away !—away !—the bubble fills—
> Farewell to earth and all its hills !—
> We seem to cut the wind !—
> So high we mount, so swift we go
> The chimney pots are far below,
> The Eagle's left behind !—
>
> Ah me ! my brain begins to swim !—
> The world is growing rather dim ;
> The steeples and the trees—
> My wife is getting very small !
> I cannot see my babe at all !—
> The Dollond, if you please !

But the insignificance of the 'mob of little men'—their ambitions, their achievements, and the rest—when viewed from high up in the sky, is admirably conceived, more particularly in respect of Hood's imaginative prospect of the contemporary world of letters :

> Come :—what d'ye think of Jeffrey, sir ?
> Is Gifford such a Gulliver
> In Lilliput's Review,
> That like Colossus he should stride
> Certain small brazen inches wide
> For poets to pass through ?

—which reflections on literary success, compared with the comparative (and unjust) neglect from which his own work had suffered, induce the thought that

> . . . only worth, above, is worth.—
> What's all the credit of the earth ?
> An inch of cloth on trust !

and lead to the recall of the words of a far greater singer,

'Oh would some Power the giftie gie 'em
To see themselves as other see 'em.'
'Twould much abate their fuss!
If they could think that from the skies
They are as little in our eyes
As they can think of us![1]

Aerostation and the Drama.

But to pass to the stage, on which the 'air-balloon', though it made an early appearance, had but a short run. As early as November 1783 it was introduced as a novel feature in a pantomime entitled *Lord Mayor's Day, or a Flight from Lapland in an Air Balloon*, and for the next year or so it was made use of as a topical attraction in harlequinades. In a few plays of the period the air-balloon was a *motif* in the plot, the most successful being a farce entitled *Aerostation, or the Templar's Stratagem*, by Frederick Pilon (1750–88), the author of many plays of ephemeral interest. The plot of *Aerostation*, which was first performed on October 29, 1784, at Covent Garden Theatre, turns on the courtship of Quarto, a bookseller—played by the well-known comedian, John Quick—and Mrs. Grumpus, a widow, the latter being inspired with the balloon craze. Quarto's nephew, Scrip, has also great ideas on the subject, and some clever fun is got out of his projects for bombarding Algiers with a 'fleet of 14 balloons, each carrying 12 cannonades, 10 bombs, and 4 twenty-pounders', an inevitable journey to the moon, and the possibility of stealing Saturn's ring for presentation to the British Museum.[2] In an anonymous farce entitled *The Mogul Tale, or The Descent of the Balloon*, 1788, the plot turns on misadventures resulting from the uncertainty of a balloon's course. A doctor prevails upon a poor cobbler and his wife to take an aerial flight, for a sum of five guineas, but the uncontrollable balloon eventually lands the party in the Seraglio of the Great Mogul, which results in a complication of amusing situations. But in both these plays, as in others, the balloon is made rather the object of ridicule than a subject for humour.[3] Moreover, the idea

[1] Hood (T.), *Poems*, by Ainger, 1897, vol. ii, p. 1. Hood also wrote an amusing poem entitled *A Flying Visit* (op. cit., p. 265), reminiscent of Poe's balloon story of *Hans Pfaall*.

[2] Pilon (F.), *Aerostation: or the Templar's Stratagem*, A farce in two Acts, 1784.

[3] Plays of a similar character were performed in Paris in June 1784 (e. g. *Le Ballon, ou la Physicomanie*). A comedy, *Il Pallon Volante*, performed at Perugia in the same year, was used as a pretext for showing play-goers a balloon on the stage. See Boffito, p. 323.

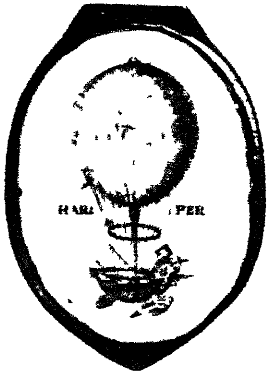


Fig 68 HARPER'S BALLOON, BIRMINGHAM, 1785
From the Lid of a Lady's Patch-box

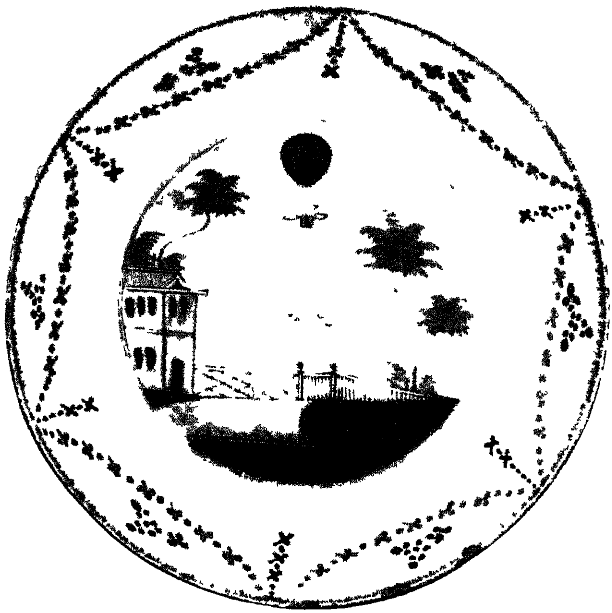


Fig 69 DESIGN OF LUNARDI'S BALLOON ON A BRISTOL-DELFT BOWL, ca 1784

was a merely topical one, and it failed to attract as soon as the novelty had worn off—much as in the use made of it in the magazines of the day.[1]

The Balloon in Caricature.

To the caricaturists of the latter years of the seventeenth and the early part of the eighteenth centuries, the balloon—with its suggestions of 'levity', 'inflation', and dubious success—afforded a novel object for pictorial satire. The earliest English caricatures were directed against balloons in a general way, or introduced them as allegorical of current political events. A typical example in the former category is one entitled 'The Air Balloon, or a Trip to the Moon' (dated November 1783), which includes figures of a 'F.R.S.' and an 'A.S.S.', while of the second is that of Fox and his Government of India Bill caricatured as 'The Political Balloon, or the fall of East India Stock', which—with others of a similar character—appeared in December of the same year. The first prints to satirize actual attempts at ballooning were those concerned with the fiasco of 'Count' Moret in August, and Keegan's British balloon in September 1784. The French origin of Moret and the general impression that his project was a hoax—a 'New Mode of Picking Pockets', as one caricaturist conceived it—was promptly depicted in figures of 'good temper'd' John Bull having his pocket picked by a specious Frenchman exhibiting 'one of the greatest curiosities dat ever de world did see', or Moret is shown ascending in his balloon holding a bag of guineas. Of Keegan's 'Folly' balloon and the important sequel of its destruction by fire, three large aquatints were anonymously 'published as the Act directs'. In one the balloon is being drawn in a cart to the place of ascent; in another it is satirically depicted as the head of a jester in a fool's cap, and a third (extremely coarse in design, and bearing the quotation from Horace, 'Caelum ipsum petimus stultitia'), represents its destruction by fire in the grounds of Lord Foley's house in Portland Place.[2] The first plate is interesting

[1] *The Rambler's Magazine, or the Annals of Gallantry, &c*, for 1783 and 1784, contained scurrilous gossip and obscene dialogues about Lunardi, &c., and similar topical allusions or sketches appeared in other contemporary magazines. The only dramatic representations of aeronautical interest that had more than a passing vogue were the performances based on *Peter Wilkins*. A 'Melo-Dramatic Romantic Spectacle' of this kind was given at Covent Garden Theatre in May 1827, and it formed the subject of the Drury Lane pantomime produced by E. L. L. Blanchard in 1860–1.

[2] *The Odes of Horace*, translated by W. S. Marris, Oxford, 1912, Ode I, iii, p. 13

'There soars no summit too sublime
For mortal fools to seek to climb—'

for its reminder of Gonsales and his gansas, which are seen in the sky, while of the second—bearing quotations from Pope's *Dunciad*—it has not hitherto been remarked that the two principal figures are evidently caricatures of Blanchard and Sheldon.[1]

From 1784 onwards the numerous caricaturists of the day made frequent and varied use of the balloon for purposes of direct and indirect satire. Aerial warfare was humorously treated in 'The Battle of the Balloons', beneath which were the following quaint lines of doggerel verse:

> Behold an odd Fight, two odd Nations between,
> Such odd Fighting as this was never yet seen;
> But such Fights will be common (as Dunce to feel Rod)
> In the year One thousand eight hundred and odd.[2]

At a somewhat later date Rowlandson caricatured the practice of following balloons on horseback, in a characteristic plate, 'Balloon Hunting', full of life and of those touches of mingled coarseness and humour common to so much of his work (Fig. 64). Unquestionably the most amusing caricature of the balloon craze which prevailed between 1820 and 1830 is 'A Scene in the Farce of "Lofty Projects" as performed with great success for the Benefit and Amusement of John Bull, Ano. D. 1825', which afforded full scope to the inimitable inventiveness and humour of George Cruikshank.[3] Indeed, the countless projects for utilizing mechanical contrivances which signalled the opening years of the era of machinery, were a fair mark for satire, and were thus treated—with much absurd ingenuity in depicting aerial conveyances—by H. Heath and other caricaturists.[4] Lennox's 'Eagle' airship project of 1835 was of course ridiculed both in caricature and humorous songs, and was made the subject of a political satire in which King William IV and his Ministers undertake the 'First Voyage of the Aerial Ship sailing to H . . . l by Steam'. Subsequently, during the long

[1] The writer has recently acquired a coloured impression of the third plate endorsed 'Lord Foley's Balloon. Designed and executed by Paul Sandby.' Cf. *D.N.B.*, vol. 50, p. 252, where the reference to Sandby's caricatures of Sheldon and Blanchard at Chelsea and Lunardi at Vauxhall is incorrect. See Lockwood Marsh, no. 47. Bruel (no. 103) says of the second plate that it was directed against Blanchard and Jeffries, which (as revealed by a comparison with his nos. 104 and 129) is clearly an error. See also Ch. IV, *ante*.

[2] The plate must have been a popular subject, for an impression in the Banks Collection is dated Dec. 16, 1784, whereas that in the Cuthbert Collection (undated) is on paper with water-mark 1821.

[3] See Fig. 65. Cruikshank did other similar plates on a smaller scale.

[4] Several of these caricatures are given in Grand-Carteret, p. 109, 112, &c.

Fig 70 PRINTED COTTON FABRIC WITH A DESIGN OF LUNARDI'S BALLOON, 1784

régime of Green—when the free balloon attained to a recognized position as an object of spectacular display—the subject ceased to attract the caricaturist, save when (as in John Doyle's well-known 'Political Sketches by H.B.') it occasionally served a turn in satirizing the politicians.[1]

The Balloon in Fashion.

In the world of fashion the balloon in early days showed itself in freakish creations by way of bonnets, toupées, muffs, ear-rings, and so forth.[2] In the hey-day of Lunardi's achievements the fascination which he personally exercised over his fair admirers created a vogue for 'Lunardi garters', and these in turn afforded the wits an opportunity for compiling verses of a character more readily imagined than quoted. But such indications of crazy interest soon passed away. Moreover, the manufacture of such souvenirs of balloons as were made in the way of jewellery, snuff-boxes, fans, and chinaware, never attained in England the popularity which encouraged extensive manufacture in France—a fact which may, perhaps, reflect the relative measure of popular enthusiasm excited respectively in that country which gave birth to the balloon, and our own, into which it was introduced as an invention of foreign and rival origin.[3]

[1] e g. one of the H.B. caricatures (no. 500) issued in Aug. 1837, was a 'Figurative Representation' of Cocking's fatal parachute descent, used (with questionable taste) to satirize the defeat of the radical politician, Joseph Hume, in the Middlesex election of the previous July.

[2] Bruel (nos. 126–7) reproduces portraits of Lunardi on satin as used to ornament a muff. The Cuthbert Collection includes pieces of printed linen material with designs incorporating Lunardi's portrait and balloon (Fig. 70).

[3] The wonderful Tissandier Collection of snuff-boxes, fans, clocks, furniture, &c., decorated with balloons and mostly of French manufacture, affords striking evidence of this statement. Cf. Lecocq (G.), *Étude sur les Faïences Patriotiques au Ballon*, Paris, 1876, where mention is made of a plate decorated with a figure of Blanchard's ascent from Chelsea, Oct. 16, 1784. See also Tissandier, vol. i, ch. viii, *L'Art, la Mode et la Fantaisie*. The only English balloon pottery the present writer has seen are a few plates or bowls of Bristol-Delft, depicting Lunardi's ascent (Fig. 69).

CHAPTER X

BALLOONING FROM 1800 TO 1850

THE decline in ballooning activity in England after about 1786 was almost equally marked in France, the true home of the invention—as may clearly be gathered from the fact that Dupuis-Delcourt only records sixteen ascents in France between 1786 and 1802. Two of these (and doubtless others not recorded) were accomplished by André-Jacques Garnerin, who achieved considerable aeronautical fame, chiefly by reason of his being the first to descend from a balloon in a parachute. It was Garnerin who made the earliest ascents of any interest in England during the early years of the nineteenth century, in one of which he repeated, for the first time in this country, his parachute exploit.

A.-J. Garnerin (1770–1825).

Garnerin, who was a native of Paris and the son of a pewterer, is said to have developed aeronautical proclivities at an early age. The period of his education at college coincided with Montgolfier's discovery, and young Garnerin's mind was captivated by the making of small balloons, to the neglect of his studies—a foible which called forth from his principal a threat of dismissal unless he abjured 'such baubles'. Having embraced the current revolutionary ideas he first came into prominence in his own country in 1795, when sent by the Committee of Public Safety on a secret mission to the Army of the North. In September of that year he was taken prisoner by the Austrian Division (commanded by the Duke of York) at the recapture of Marchiennes, and for over two years was detained as a captive in Hungary. Exchanged as a prisoner of war Garnerin returned to Paris, and on finding that he was not likely to receive any reward for his services turned his attention to aeronautics.[1] Under the Directory and during the early days of the Empire, he became the official aeronaut of the government, an appointment which enabled him during 1801 to obtain letters of introduction to the ambassadors of the countries he wished to visit. His first journey was to England, and subsequently he travelled to Prussia and Russia, receiving a cordial welcome at the hands of the two ruling emperors. His energy and courage called forth support

[1] *European Magazine* for July 1802, p. 28.

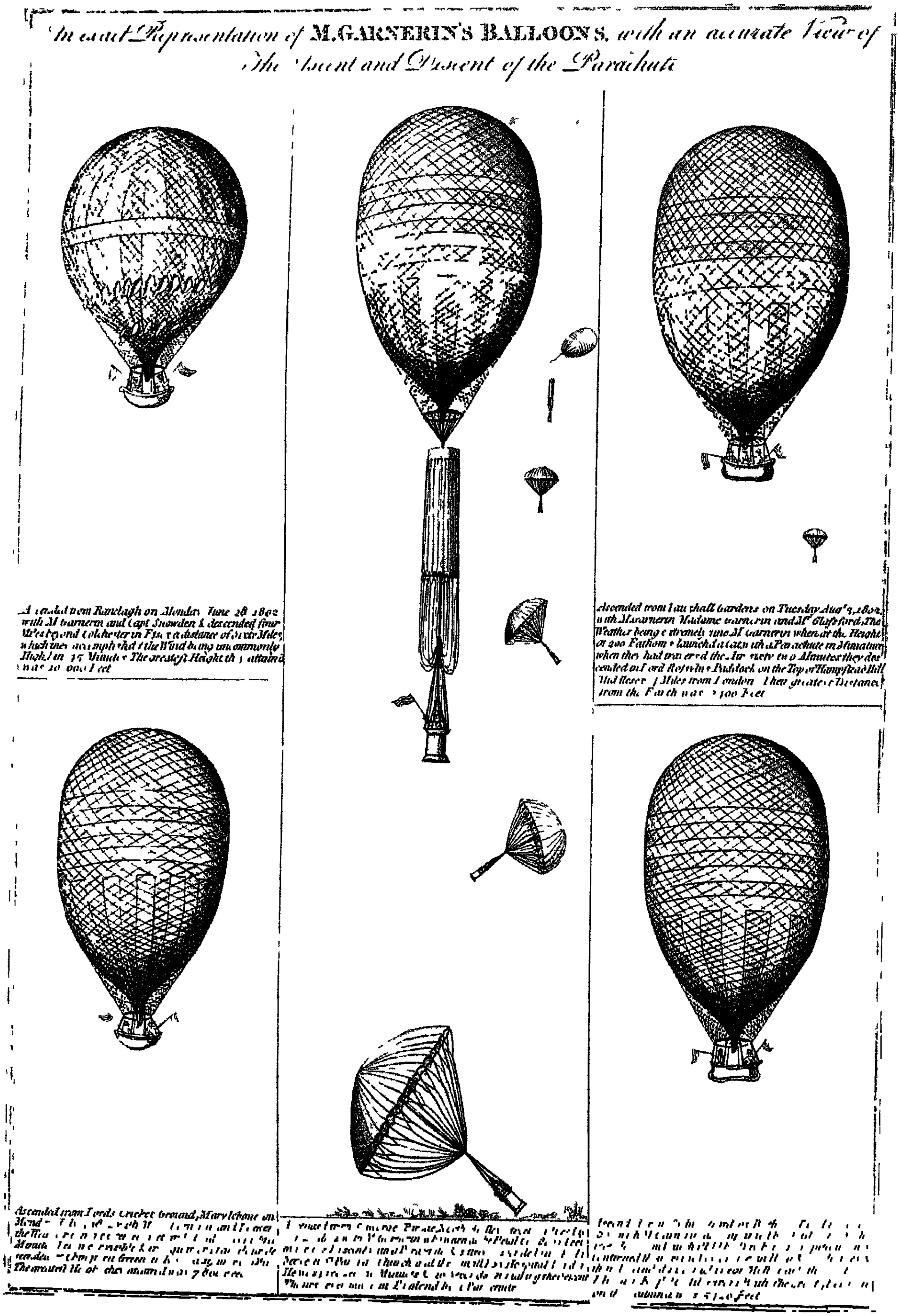


FIG 71 GARNERIN'S BALLOONS AND DESCENT OF THE PARACHUTE, JUNE–SEPT. 1802.

from the celebrated astronomer Lalande, his patron and friend (who was present at the first experiment), and having acquired the title of 'Aérostier des Fêtes Publiques', Garnerin was called upon in that capacity to arrange for an aeronautical display on the occasion of the coronation of Napoleon on December 3, 1804. To add to the gaiety of the fête he constructed five or six balloons, one of which was not only larger and more highly decorated than the others, but had suspended beneath it, in place of a car—for the balloons were not intended to carry pilots—various symbolical ornaments, surmounted by a wreath of laurels.[1] It was currently reported that this balloon was carried over the Alps to Rome, where the laurel wreath fell on the tomb of Nero—an incident greatly distasteful to Napoleon's superstitious temperament, and one which aroused his anger against Garnerin.[2] The story seems highly improbable, but it is clear that from this date Garnerin ceased to be officially employed. Notwithstanding he continued his aeronautical activities for over twenty years, and died from injuries received in the theatre of the Beaujon Gardens in Paris, on August 18, 1825. Like his compatriot Blanchard, Garnerin, though physically a small man, was amply endowed with those vivacious and demonstrative qualities characteristic of his race. Though he made some pretensions to scientific attainments he was in reality lacking in such knowledge and made no observations of scientific value, nor (as far as is known) did he make any contribution of importance to the technical management of balloons.[3] On the other hand it must be admitted that he showed admirable pluck on more than one occasion, notably in his parachute descents, in which latter respect he was certainly a true pioneer.[4]

Garnerin's First Ascent in London, June 28, 1802.

Garnerin's first ascent in London was made from Ranelagh, on June 28, 1802, with Captain R. C. Sowden as passenger.[5] Despite unfavourable weather the ascent was witnessed by immense crowds on both banks of the river, augmented by the

[1] A beautiful aquatint of the balloons ascending was engraved by Marchand after Le Cœur. (See Bruel, nos. 168 and 169, also Lockwood Marsh, no. 68.)

[2] The fact that this show balloon was launched merely for spectacular effect is sometimes overlooked. Coxwell was thus misled into believing that Garnerin himself travelled 900 miles in the air—'the most lengthy and glorious trip on record' (*The Balloon Mag.*, 1845, p. 50, &c.).

[3] Tissandier refers to Garnerin as a pupil of the scientist Charles (vol. i, p. 146).

[4] See Ch. XIV, on Parachutes, p. 323 *et seq.*

[5] Garnerin had previously announced that his parachute experiment would take place from Marlborough Gardens, Chelsea, on June 2nd.

gathering in St. James's Park, assembled in the afternoon to see the King return from the House of Lords, his majesty himself watching the balloon later from Buckingham Palace. Owing to the wind and rain Garnerin pressed Sowden to forego the trip, but as the latter would not be denied, the balloon was released about 5 o'clock in the afternoon and was driven rapidly across London by a 'fresh gale' from the south-west. Having risen as Sowden relates, to a height of 15,000 feet, Garnerin opened the valve, when a rapid descent was made about four miles beyond Colchester, something over fifty-one miles from London, the voyage having occupied only three-quarters of an hour, equivalent to a speed of seventy miles an hour. On nearing the earth the anchor and cable were thrown out, but owing to the violence of the wind the anchor failed to hold and dragged over fields and through bushes and hedges. It then caught in a thicket, but as no assistance was forthcoming—on the contrary the occupants of a house close by are said to have threatened to fire on the endangered aeronauts—the cable broke, and the balloon was immediately driven against a tree, enabling both Garnerin and Sowden—the latter having shown great pluck in declining to jump earlier—to make a perilous escape, with no worse injuries than severe bruises.[1] A week later Garnerin made his second ascent, this time from Lord's Cricket Ground, accompanied by Edward Hawke Locker, who paid a considerable sum for a trip.[2] Again there was a high wind—Locker called it a 'heavy gale'—and the parachute experiment (which had been announced to 'irrevocably take place' on this date) had to be further postponed. Shortly before 5 o'clock the balloon rose rapidly, and was lost to sight in about three minutes in dark and heavy clouds, to the consternation of 150,000 people who had waited in the rain, with some signs of impatience, for over two hours. The ascent on this occasion—doubtless owing to the weather—only lasted about

Second Ascent, Lord's Cricket Ground, July 5, 1802.

[1] Richard Choyce Sowden joined the Navy at an early age and was posted lieutenant before he was twenty-one. Left a fortune by his father—who founded the Philosophical Society of Amsterdam—he dissipated his estate and took to the stage under the name of Stapleton, dying from consumption at the age of thirty-one. After the above-mentioned ascent he accompanied Garnerin to Paris, where he made a second ascent.

[2] E. H. Locker (1777–1849) was at this time in the Navy Pay Office, and afterwards became Civil Commissioner of Greenwich Hospital, where he established the Royal Naval Gallery. See Locker-Lampson (F.), *My Confidences*, 1896, p. 60, where the author incorrectly states that his 'father was the second Englishman' who ascended in the air. From a sketch made during this voyage Locker engraved a portrait of Garnerin, an impression of which (taken in 1831) he presented to John Cuthbert (Fig. 73, inset).

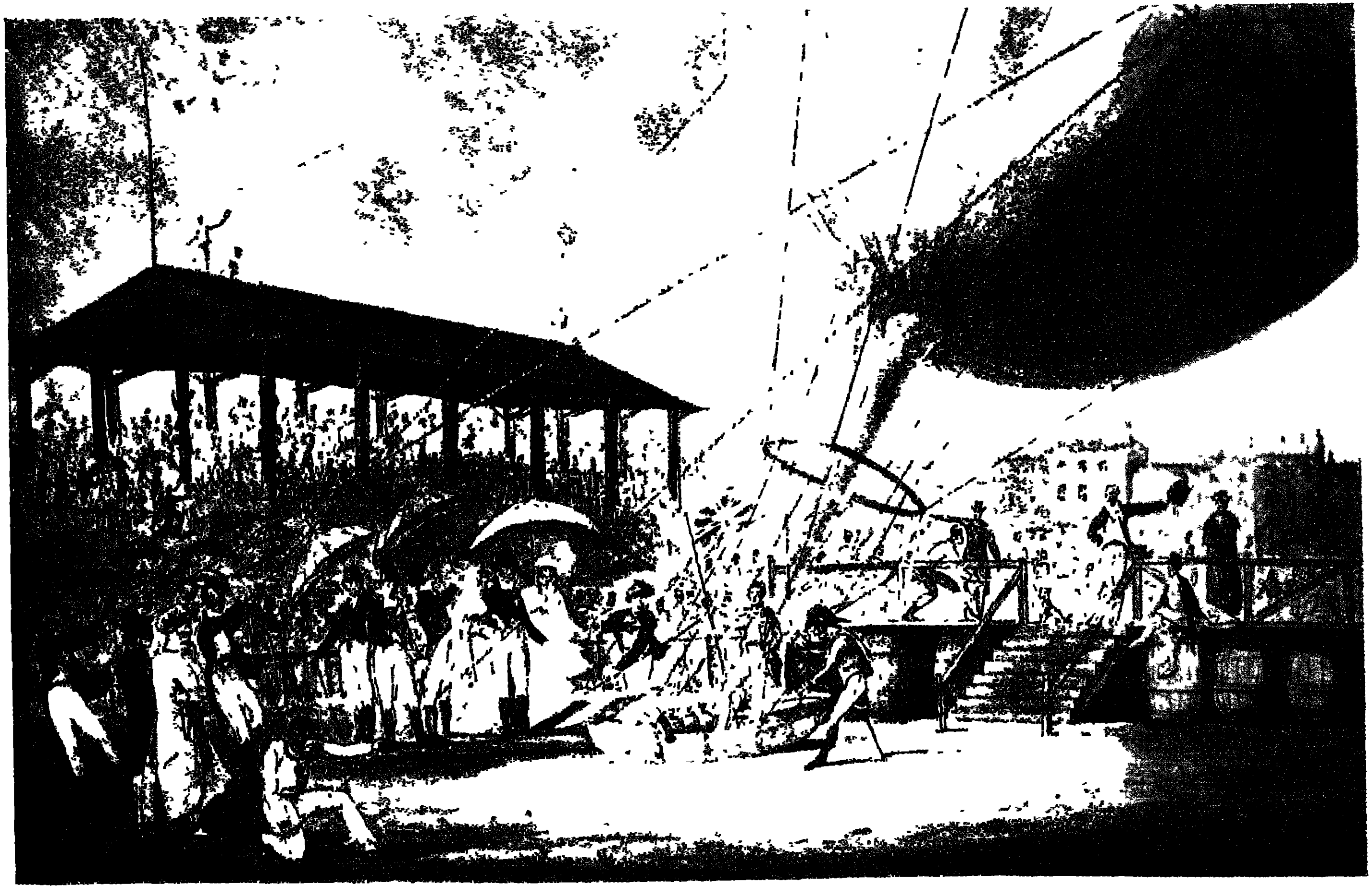


Fig 72 ASCENT OF GARNERIN AND E H LOCKER FROM LORD'S CRICKET GROUND
July 5, 1802

a quarter of an hour, when a landing was effected with some difficulty at Chingford Green in Essex.[1] Striking the ground with considerable force, the balloon rebounded to 200 feet, and on again descending Garnerin received a severe blow from striking against a tree. He subsequently assured Locker that this was the first occasion in his aeronautical career, extending over twelve years—the present ascent being his twenty-seventh ascent—that he had ever suffered an accident of this kind, though the experience of the previous week must have been at least as hazardous a venture.

A third ascent—this time from Vauxhall—followed on August 3rd, when Garnerin was accompanied by his wife, Madame Garnerin, and Duncan Glasfurd.[2] The day was very calm and Garnerin offered to make his much-advertised parachute descent—an offer which he says was declined, though he does not add for what reason. The ascent was not made until 7.30 p.m., the only incident in it being the successful release of a small parachute, beneath which was suspended a cat. Subsequently Garnerin's balloon, and the parachute in which he was to make his 'novel and extraordinary experiment', were exhibited at the Pantheon. The latter venture was once more announced to take place from St. George's Parade, Grosvenor Square on August 26th, but the bad weather necessitated yet further postponement, which was publicly announced by means of hand-bills on the afternoon of the appointed day. Meanwhile, pending a later arrangement, Garnerin travelled down to Bath, where on September 7th he made an ascent (again accompanied by Glasfurd) from Sydney Gardens. In favourable weather, with a light breeze from the north-east, the balloon rose at 5.30 p.m. and ascended to 3,000 feet, at which elevation the aeronauts experienced intense cold, a fact attributed by Garnerin to 'a thick black cloud which floated over the balloon', and he records that, not wishing to 'meet the fate of Icarus', he desired to avoid it, 'thinking it was electric'. After being in the air about three-quarters of an hour more ballast was released on a downward run, and the balloon rose through the clouds to an 'estimated height of 5,420 feet', where they enjoyed the rays of the setting sun. Finally—to quote from a contemporary

Ascent from Vauxhall, Aug. 3, 1802;

and Bath, Sept. 7, 1802.

[1] Locker made a sketch of the scene at Lord's (then on the site of what is now Dorset Square), depicting Garnerin and himself in the car of the balloon on the point of departure (Fig. 72).

[2] Garnerin's wife, Jeanne Geneviève, was also a professional aeronaut and made parachute descents. His niece, Elisa Garnerin, also gave numerous exhibition parachute displays throughout Europe.

account of this 'aerial excursion', the first that Bathonians had enjoyed—

> . . night drawing on, cold, dreary, and dark,
> They made their descent, lucky souls! at Mells Park—
> Where old hospitality holds a snug corner,
> As unlimited butler to good Squire Horner.[1]

His Parachute Exploit, Sept. 21, 1802

On his return from Bath Garnerin promptly renewed the advertisement of his parachute exploit, now finally fixed for September 21st. Doubtless the several postponements on account of bad weather had raised doubts in the public mind, and Garnerin apparently thought it necessary to guard against the ill-consequence of further delays by stating, with ostentatious assurance, that should such again be the case, 'he would most certainly perform an Aerial Journey exclusively devoted to Scientific Researches, and would explore through the Atmosphere as much of the Island as possible, in anxious hopes of adding his Mite to the attainment of so many desirable objects which could derive from his exertions'. Favoured at last, however, by fine weather, the exploit was successfully accomplished from the Parade Ground of the St. George's Volunteers, situated on the north-east side of North Audley Street, Grosvenor Square.[2]

Francis Barrett's Balloon, Aug 1802.

Doubtless the interest created by Garnerin's visit gave some impetus to ballooning in this country. During July a young apothecary of Greenwich, Francis Barrett, constructed a large balloon in which he announced his intention to ascend from the enclosed garden of a Mr. Andrade, at the foot of Maze Hill. Captain Sowden—Garnerin's companion on June 28th—having expressed a wish to accompany Barrett, it was necessary to increase the capacity of the balloon, with the result that on the appointed day it was not found possible to fill the enlarged envelope in time. A postponement was announced by means of posters and the agency of the town-crier, and the next day the attempt was renewed, Glasfurd assisting in the inflation, while both Garnerin and his wife were present as interested spectators. The public, who had realized long since that it was not necessary to pay for admission to witness a sight which could, as Johnson suggested, be seen from without free of charge, crowded the slopes of Greenwich Hill, while the walls, house-tops, and neighbouring chimneys even, were thronged with people. After hours of fruitless labour,

His Attempted Ascent, Aug 13, 1802.

[1] *The Monthly Visitor*, vol. ii, 1802, p. 91.

[2] See Ch. XIV, p. 323.

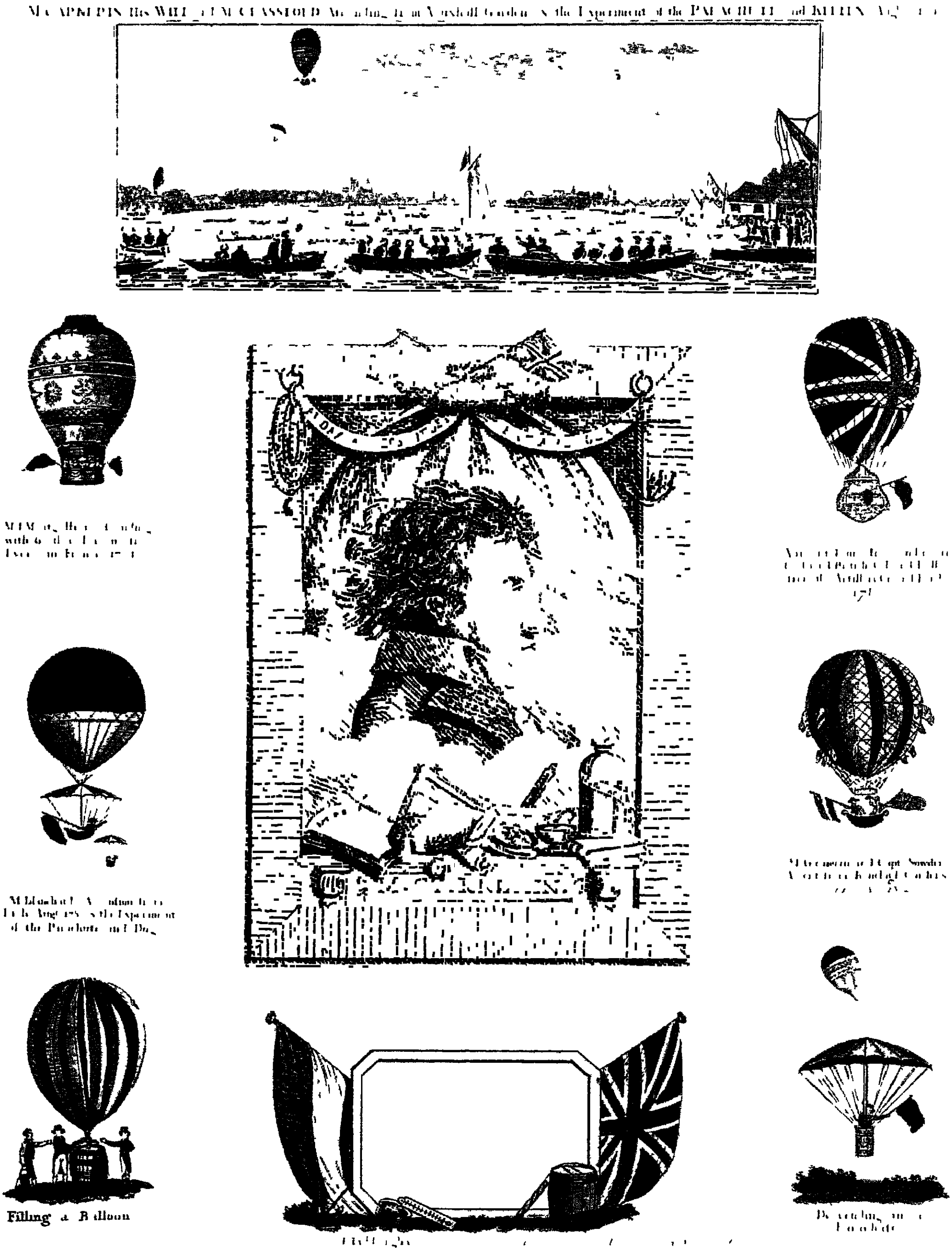


FIG 73. SOUVENIR WRITING-SHEET OF GARNERIN'S ASCENTS IN 1802

Inset. Portrait of Garnerin, by E. H. Locker.

spent in endeavouring to fill the balloon—during which 'that animal, so much censured as the most ill tempered and unmanageable in the world, an English mob', preserved exemplary good order—it was realized just before dark that it would be impossible to make an ascent. Thereupon Barrett, doubtless in order to propitiate those who had paid for admission, let go the cords, and the balloon—made of an 'extremely party-coloured texture, resembling a patch-work counterpane'—rose with merely a child's cradle and two flags attached to it.

Again Fails at Swansea, Oct. 6–15.

Early in October Barrett renewed his aerostatic venture at Swansea, but two attempts made from the Ball Court ended in failure. From Barrett's own descriptive and amusing account of his experiments, it is evident he had neither the knowledge nor the experience necessary for the undertaking. On October 6th a whole day was spent in a futile attempt at inflation, and when (late in the afternoon) Barrett stood up to apologize for his failure, almost before he began to speak, the staging gave way with a crash, and—like Mac Flecknoe in Dryden's satire—the declaiming aeronaut was ignominiously precipitated to the ground. About ten days later, owing to financial help from two gentlemen of the locality, he made another attempt, and this time just sufficient 'lift' was obtained to carry the balloon—without any ballast—about four fields away from the place of ascent, after which Barrett was carried over fields and hedges a short distance off the ground. Alighting, he opened the valve and let the balloon go, and after an hour or so it fell some six miles away.[1]

Thomas Harris.

Though the Sadlers, father and sons, doubtless added in some measure to the general fund of ballooning experience, it is nevertheless true that the science of ballooning, or the art of piloting the balloon, remained stationary during the early years of the nineteenth century. By a strange and ironic fatality the aeronaut who set out to remove the reproach, was himself fated to be the first English victim to the cause. Little is known of Thomas Harris beyond the circumstances of his tragic death.[2] On September 5, 1823, he made an ascent with George Graham from a timber yard in Berwick Street, Soho, and fifty-five minutes later a safe landing

His Ascent from London, Sept. 5, 1823.

[1] News-cuttings in Cuthbert Collection. After the second failure—when his balloon was taken up by two labourers and cut in half with the idea, as they said, of letting the aeronaut out—Barrett evidently abandoned further attempts.

[2] From a letter in the Cuthbert Collection—the last ever written by Harris—it would appear that he was not a man of any education. He is said to have worn a 'blue suit of naval uniform' on the occasion of his fatal ascent.

was made in Lord Darnley's Park near Rochester.[1] He subsequently issued a circular in which he announced the completion—at the cost of nearly a thousand guineas—of a large balloon, named 'The Royal George', having a capacity of '176,860 gallons of gas, and capable of lifting three persons'. Harris averred that 'the Science of Aerostation [having] lately fallen into much decay, and [having] been the subject of Ridicule, through the total want of invention in those who have come forward as Aeronauts', he had discovered improvements which would overcome 'the great difficulty, and extreme danger' experienced in effecting a landing, a danger certainly exemplified in several of the elder Sadler's exploits, even if it was not the actual cause of his son's death. The improvement he designed was a new type of valve, which would enable the aeronaut to 'discharge the whole of the gas in an instant'.

His Fatal Ascent from Eagle Tavern, May 25, 1824.

Having exhibited the balloon at the Royal Tennis Court, Great Windmill Street, Haymarket, he made an ascent on May 25, 1824, from the Eagle Tavern, City Road, accompanied by Miss Stocks, a young girl from that locality. When over Beddington Park, near Croydon, the balloon suddenly fell with fearful velocity, the car crashing into an oak tree in the park, with the result that Harris was killed on the spot, his companion eventually recovering from her severe injuries.[2] Some French writers have suggested, that Harris, in a spirit of admirable chivalry, deliberately jumped from the car when nearing the earth in order to lighten the load and thus diminish the rapidity of the fall—a suggestion which is indeed supported by the fact that Miss Stocks survived. At the subsequent inquest it transpired that the 'improved' valve, used on this occasion for the first time, was of a duplex type—a large one, fitted as usual at the top of the balloon, within which was a smaller one—and in the opinion of Graham the aeronaut, the accident was due to Harris having pulled the wrong line.[3]

George Graham and Mrs. Graham.

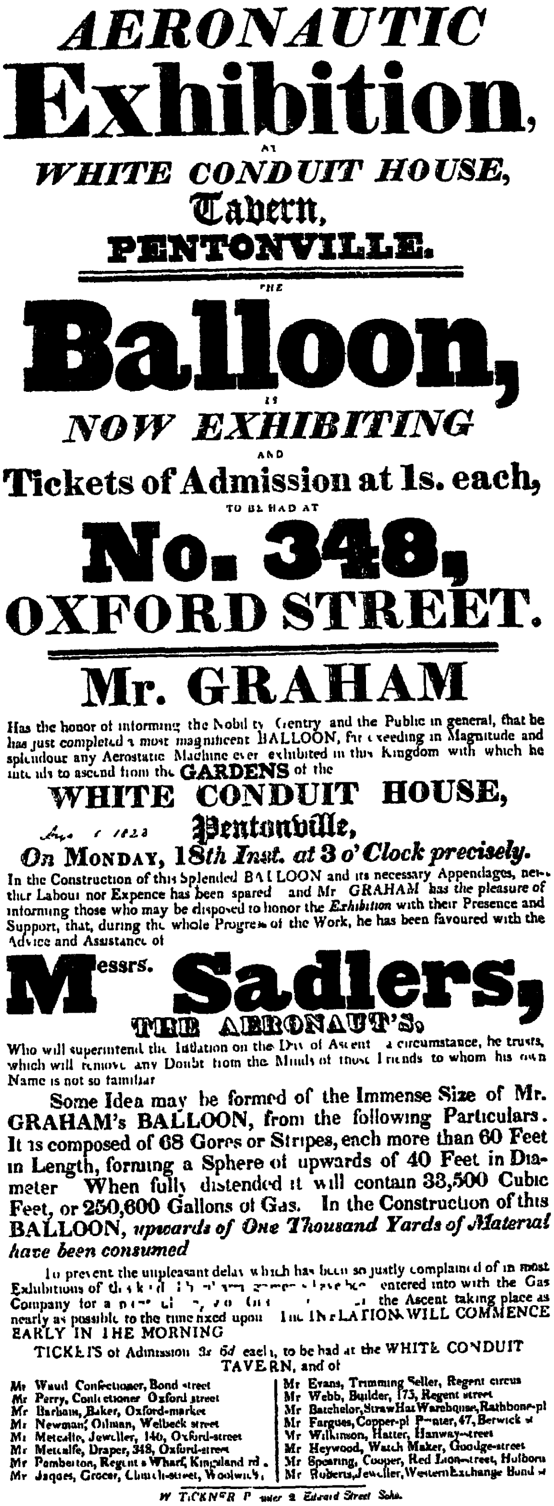
But if Harris's assertion as to the decay in ballooning at this period be true, it cannot be doubted that the introduction of coal-gas for inflation by Charles Green—who, as recorded in

[1] Graham afterwards repudiated suggestions that Harris had any connexion with his balloon. He merely asked Harris to 'step in' to the car on Sept. 5, owing to the non-appearance of Sadler junr., who was to have accompanied him.

[2] An engraving of the accident, from a drawing made on the spot by T. T. Dales, (Fig. 74) was copied to illustrate an accident at Sunderland in 1859, as related by Coxwell in the second series of his *Balloon Experiences*, 1889, p. 59.

[3] Cf. the opinion of Chas. Green as given by Monck Mason in *Aeronautica*, pp. 261–3.

FIG. 74. FATAL ACCIDENT TO THOMAS HARRIS, BEDDINGTON PARK, CROYDON, MAY 25, 1824


AERONAUTIC
Exhibition,
AT
WHITE CONDUIT HOUSE,
Tavern,
PENTONVILLE.
THE
Balloon,
IS
NOW EXHIBITING
AND
Tickets of Admission at 1s. each,
TO BE HAD AT
No. 348,
OXFORD STREET.

Mr. GRAHAM

Has the honor of informing the Nobility, Gentry and the Public in general, that he has just completed a most magnificent BALLOON, far exceeding in Magnitude and splendour any Aerostatic Machine ever exhibited in this Kingdom with which he intends to ascend from the GARDENS of the

WHITE CONDUIT HOUSE,
Aug. 1823 Pentonville,
On MONDAY, 18th Inst. at 3 o' Clock precisely.

In the Construction of this Splendid BALLOON and its necessary Appendages, neither Labour nor Expence has been spared and Mr GRAHAM has the pleasure of informing those who may be disposed to honor the *Exhibition* with their Presence and Support, that, during the whole Progress of the Work, he has been favoured with the Advice and Assistance of

Messrs. Sadlers,
THE AERONAUT'S,

Who will superintend the Inflation on the Day of Ascent a circumstance, he trusts, which will remove any Doubt from the Minds of those Friends to whom his own Name is not so familiar

Some Idea may be formed of the Immense Size of Mr. GRAHAM's BALLOON, from the following Particulars. It is composed of 68 Gores or Stripes, each more than 60 Feet in Length, forming a Sphere of upwards of 40 Feet in Diameter When fully distended it will contain 33,500 Cubic Feet, or 250,600 Gallons of Gas. In the Construction of this BALLOON, *upwards of One Thousand Yards of Material have been consumed*

To prevent the unpleasant delay which has been so justly complained of in most Exhibitions of this kind [illegible] entered into with the Gas Company for a [illegible] the Ascent taking place as nearly as possible to the time fixed upon The INFLATION WILL COMMENCE EARLY IN THE MORNING

TICKETS of Admission 3s 6d each, to be had at the WHITE CONDUIT TAVERN, and of

Mr Waud Confectioner, Bond street	Mr Evans, Trimming Seller, Regent circus
Mr Perry, Confectioner Oxford street	Mr Webb, Builder, 175, Regent street
Mr Barham, Baker, Oxford-market	Mr Batchelor, Straw Hat Warehouse, Rathbone-pl
Mr Newman, Oilman, Welbeck street	Mr Fargues, Copper-pl Printer, 47, Berwick st
Mr Metcalfe, Jeweller, 140, Oxford-street	Mr Wilkinson, Hatter, Hanway-street
Mr Metcalfe, Draper, 348, Oxford-street	Mr Heywood, Watch Maker, Goodge-street
Mr Pemberton, Regent's Wharf, Kingsland rd.	Mr Spearing, Cooper, Red Lion-street, Holborn
Mr Jaques, Grocer, Church-street, Woolwich,	Mr Roberts, Jeweller, Western Exchange Bond st

W TICKNER Printer 2 Edward Street Soho.

Fig. 75.

the next chapter played so prominent a part in the ballooning annals of his day —made the actual process of ascent much more certain and easy. The advantages of this improvement facilitated the exploits of such purely professional aeronauts as George Graham and his wife Margaret, who (at a later date) claimed to be 'Her Majesty's Aeronauté' and the 'only English Female Aeronaut'.

Graham's first attempt —in announcing which he admitted his indebtedness to the Sadlers 'for advice and assistance in the construction and for the process of inflation'—was at White Conduit House Tavern, Pentonville, on August 18, 1823. The balloon was made of lawn, oiled and varnished, and measured 40 feet in diameter, with a capacity of 250,000 gallons of gas, nearly twice as large as any balloon hitherto constructed. Owing to the diffusion of gas through the envelope, and to heavy rain, the inflation was a failure, with the result that Graham—as Barrett had done before—cut the balloon free 'and literally consigned it *au gré des vents*', a proceeding which was

Graham's First Attempt, Aug. 18, 1823,

ineffectual in preventing a violent outburst on the part of the crowd, ending in a riot. However, on September 5th he made a successful ascent from Berwick Street, Soho, accompanied by Thomas Harris, and thereafter up to as late as 1852 he continued

and First Ascent, Sept. 5, 1823.

DROPPED FROM

Mrs. GRAHAM'S

BALLOON!

On TUESDAY, Aug. 2, 1836,

In latitude nearly 51°, at an elevation of upwards of TEN THOUSAND FEET, scarcely perceptible but to telescopic observation, under sideral influence, and gently propelled by Eolus.

THIS BILL,

Thus sent on its earthly errand, is to announce to the sublunary world, that even at this distance from it, report has reached the passengers of the Ærial Machine, that the successful Drama of

BOUND 'PRENTICE

TO A WATERMAN!

With a variety of

NOVEL ENTERTAINMENTS,

are performed **EVERY EVENING,** at the

SADLER'S WELLS THEATRE

From which place this Balloon has taken flight, and where Mrs. GRAHAM will appear this Evening at Ten o'Clock.

BOXES, 2s. PIT, 1s. GALLERY, 6d.

S. G. Fairbrother, Printer, Exeter Court, Strand.

Fig. 76.

to make ascents for spectacular purposes and public amusement. Doubtless he became a pilot of considerable experience, but his ascents (as also those made by his wife) were not infrequently accompanied by accidents. On his sixth ascent from Pentonville, on June 2, 1824, Graham was accompanied by his wife, who was at this time only twenty years of age, while in May of the year

Pentonville, June 2, 1824.

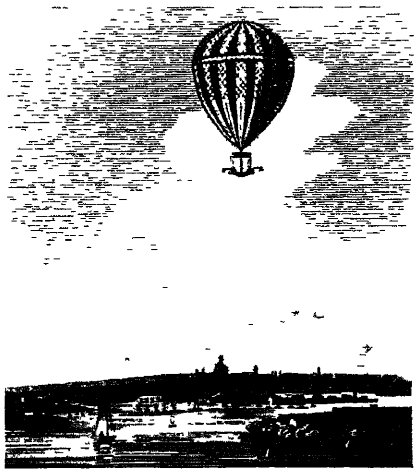


Fig. 77 GRAHAM'S BALLOON, 1823
From a Bill-head of Richards & Co., Linendrapers, Oxford Street, London

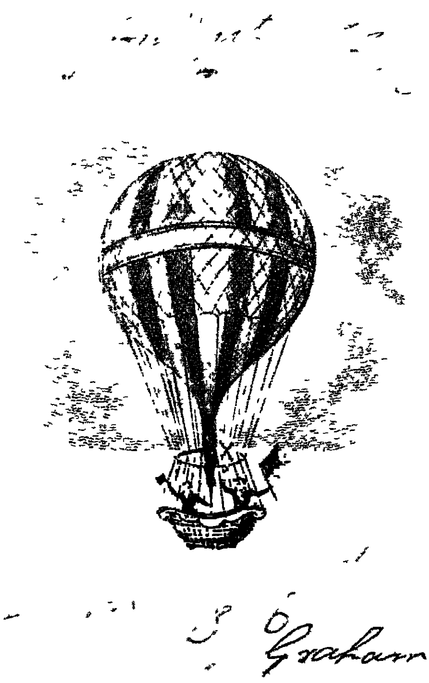


Fig. 78 Signed Admission Ticket for an Ascent of Graham's Balloon

Fig. 79.

following he ascended from Mile End and was accompanied by two passengers, one of whom paid £30 'for permission to put his neck in jeopardy'. In August he had an unfortunate experience at Chelmsford owing to failure in the inflation, and in November both he and his wife, after an ascent at Plymouth, fell in the sea and were rescued in an exhausted condition.[1]

Ascent with Two Passengers, May 2, 1825.

In later years Mrs. Graham appears to have become the more active partner in their joint aeronautical ventures, and in July 1836 she ascended for the first time with another woman. On August 22, 1836, she made an ascent with the Duke of Brunswick, when owing to a bad landing Mrs. Graham was thrown out of the car and severely injured. In the controversy which followed as to the cause of the accident—due probably to the premature alighting of the duke—Mrs. Graham stated with characteristic exaggeration that she fell from 1,000 feet, though even an eye-witness put it at 100, the suggestion being made that her dress acted as a parachute—in the manner of the amusing if immodest caricature of 'Balloon Hunting' by Rowlandson

Mrs. Graham's Ascent with the Duke of Brunswick, Aug. 22, 1836.

[1] Eleven years later Graham learned that the balloon, which on this occasion escaped after their rescue, was subsequently seen and identified off Gibraltar.

(Fig. 64)—and thus broke the violence of her fall. But she showed remarkable pertinacity and pluck in face of this and other dangerous adventures, her first ascent after this accident being made from the Surrey Zoological Gardens on April 27th next year, when she described her voyage—a short one ending in Sir Samuel Scott's Park at Bromley —as 'the most delightful she had ever experienced'. As an attraction to her ascents she adopted in 1837 the practice of releasing a small parachute with a monkey, while on the occasion of an ascent made for the benefit of the widow of Robert Cocking in the 'Royal Victoria' balloon from Hackney in August 1837, she let down two model parachutes, one of the Garnerin and the other of the Cocking type, which latter is said to have made the better descent. In June 1838 an ascent made from the Green Park (by engagement with the Government, as part of the coronation festivities) ended in a fatal accident, the grapnel tearing off a coping-stone from a house in Marylebone Lane, which resulted in the death of a passer-by.[1]

Green Park, June 28, 1838.

Her Accident in Arlington Street, June 16, 1851.

A still more exciting termination followed her ascent with her husband from Batty's Hippodrome, Kensington Road, on June 16, 1851. At the outset a rent made in the fabric of the balloon by striking a pole on the top of the building, necessitated throwing out all the ballast when above the Crystal Palace, erected in Hyde Park for the Great Exhibition. The grappling iron, which did considerable damage as the balloon drifted just above the houses, eventually caught in the coping-stone on the top of Colonel North's mansion in Arlington Street, St. James's, when both the Grahams were thrown out on the roof, whence they were rescued by the police in an insensible condition. Graham himself was seriously injured, and this may have led to the termination of his ballooning career. His wife continued, however, despite this latest of a long series of accidents, and made her eighty-first ascent from the Gardens of Flora, Camberwell, in September 1852. Her last recorded flight was another roof-skimming exploit made on August 19, 1853, from the Rotunda Gardens in Dublin. It can only be said that she owed the continuance of her long aeronautic career —extending over nearly thirty years—to extraordinary luck rather

[1] At the inquest Charles Green gave evidence against Mrs. Graham on the ground that the silk of her balloon was unfit for flight in stormy weather. Mrs. Graham retorted by producing (as she alleged) a piece of the silk of Green's balloon, which, however, he denied to be the material he used.

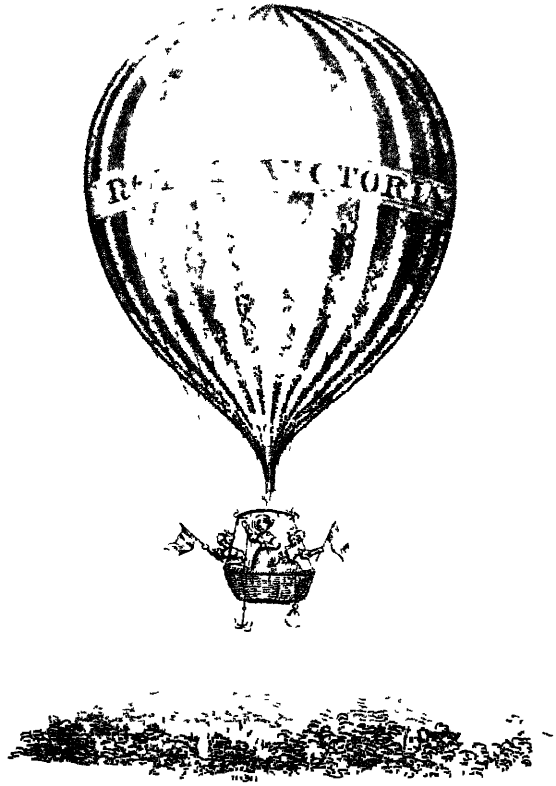


FIG. 80. Ascent of Mrs Graham's 'Royal Victoria' Balloon, Aug. 9, 1837. The first ascent of three Englishwomen.

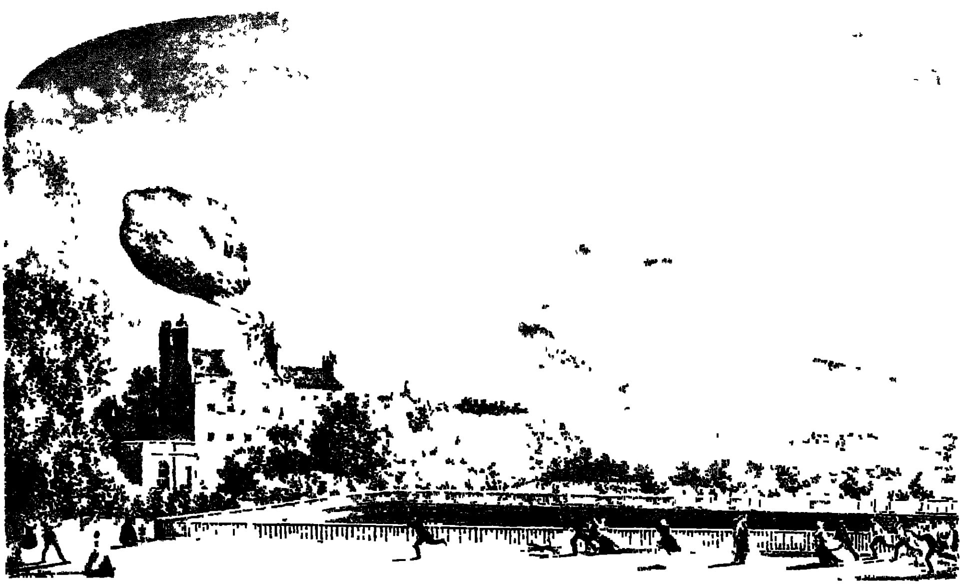


FIG. 81. Accident to Mr. and Mrs. Graham's 'Victoria and Albert' Balloon Arlington Street, Piccadilly, June 16, 1851.

than to any technical skill or judgement in the handling of balloons.

The Grahams, it must be admitted, have but little place in the scientific development of the free balloon, and like other professional aeronauts of the period they used the balloon, for the most part, as they found it. It is true that Mrs. Graham claimed on more than one occasion that her husband had devised an appliance which would bring about a revolution in flying, and by means of which he would be able to control the balloon and remain in the air indefinitely.[1] But this, as indeed countless other similar claims, came to naught, though doubtless time and money were spent from time to time in devices intended to increase the utility of the free balloon and render it more capable of efficient control.

Cornillot's Ascent from Seal, Aug. 23, 1825.

For example in August 1825 P. Cornillot made an ascent (in company with T. R. Jolliffe) from the village of Seal, near Sevenoaks, in Kent, on which occasion he claimed—as stated on the lithographic print of his balloon—to have 'established the principle of sailing in an horizontal direction at any required point of elevation '.[2] But beyond the fact that Cornillot made two later ascents in June 1826 from St. John's Wood Farm—when it was said that the balloon (inflated with hydrogen) 'certainly seemed' to sail on a horizontal course—nothing further is known of his scheme.

Dean's Hot-air Balloon, June 23, 1825.

A more futile scheme of a retrograde character was that projected by Dean in June of the same year, when he tried unsuccessfully to ascend in a balloon inflated on the practically obsolete 'Montgolfière' or 'hot-air' principle.[3] This was not, however, the last attempt of the kind, for in the spring of 1838 J. W. Hoar constructed a huge hot-air balloon. Hoar appears to have been interested a year or so earlier in a ballooning company called the 'Aeronautic Association', formed to render the 'Science of Aerostation applicable for the purposes of Geographical Survey', the unexplored regions of Africa in particular. A prospectus—with sufficient particulars as to bankers, secretary, office, and so forth—inviting shareholders to take up capital to the extent of

The Aeronautic Association, 1837.

[1] A woodcut of Graham's 'Steering Apparatus' (Cuthbert Collection, dated June, 1852) shows four inefficient looking wings attached to the hoop and worked by treadles.

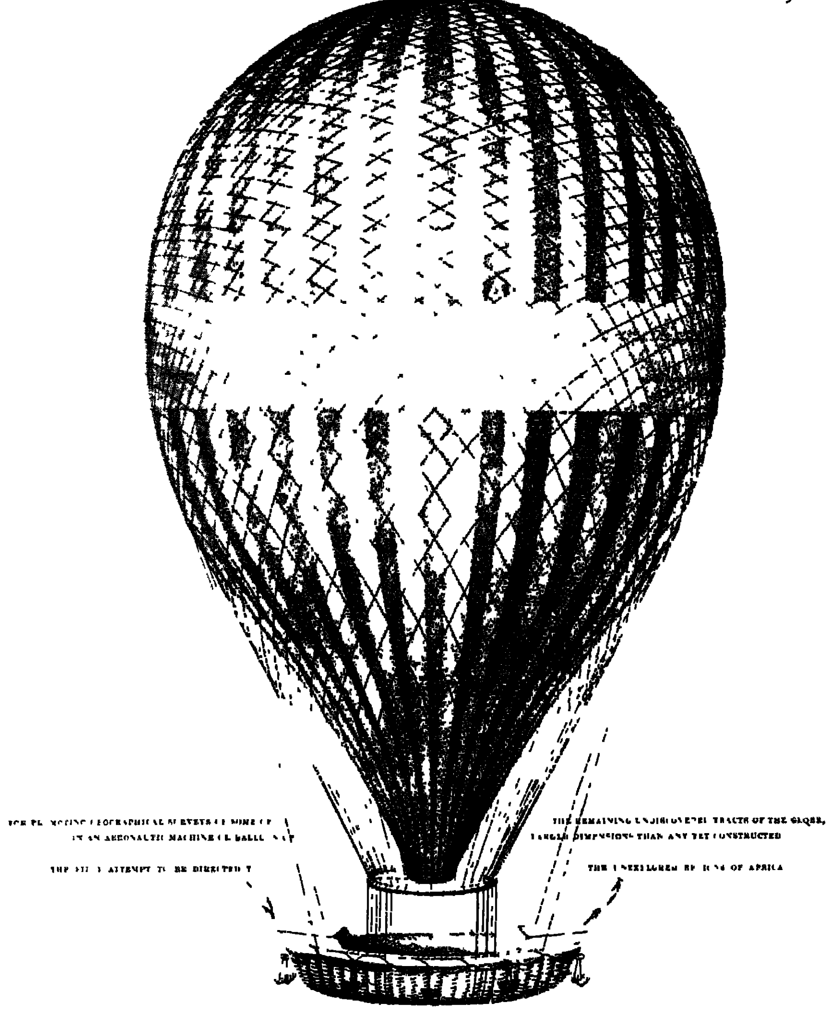
[2] The plate (Fig. 83) is dedicated to 'Monsieur T. R. Jolliffe'. It is reproduced in *Astra Castra*, p. 270. Major B. F. S. Baden-Powell possesses a contemporary MS. account of this ascent.

[3] The Cuthbert Collection comprises a small piece of fine linen with the following manuscript note. 'Dean's Rarefied Air Balloon which was exhibited at the Belvedere Gardens, Islington, 1819, Presented by himself to John Cuthbert.'

£8,000, was issued with a print of the proposed balloon on the front page, and a note to the effect that Graham would superintend the construction of it. In the opening lines of the prospectus, wherein is unfolded the grandiose scheme for exploring Africa from Sierra Leone to Cape Guardafui or the Cape of Good Hope—voyages which might ' require the aeronauts to remain up ' for a month or two, as would be perfectly feasible with the ' equipment now contemplated '—investors were offered the prospect of a return of their capital within twelve months, and a considerable profit at once, the latter being quite apart from the ultimate profit of from 100 to 200 per cent. which the ultra-sanguine projectors anticipated. In the face of such financial inducements—surely unsurpassed in the history of specious company promoting—the ensuing paragraph, with its regrets that the science of aerostation had hitherto ' had no better purpose than that of amusement and wonder on the one hand, and pecuniary gain on the other ', is hardly impressive.

That the scheme failed to materialize cannot be doubted, but it may be briefly described, if only because it was apparently the first joint-stock undertaking of the kind. The balloon was to be of ' great spherical capacity '—in order to take advantage of the augmented ratio of lift which results from increased cubic capacity—with a dual envelope of silk, rendered as impermeable as possible to hydrogen gas, the plant for generating which would be set up in Africa at a point not then ' irrevocably determined '. With foresight that was ingenious but impracticable, the inventor designed the balloon so that in the event of ' a total loss of the original gas ' it could be employed as a ' Montgolfier, or Heated-Air Balloon ', and he extended his consideration for the safety of the aeronauts to the construction of a car capable of being converted ' in any case of emergency ' into a ' perfect sea-boat '. As a source of immediate profit the building of the balloon was to be the subject of public exhibition, and on completion it was anticipated that—by reason of its great *novelty* and *extraordinary dimensions*—further considerable dividends would be earned by ascents throughout Great Britain and on the Continent. Finally the projectors undertook to equip the balloon, manned by six aeronauts—including ' a surgeon (naturalist), geographer, and draughtsman ' for exploring the immense expanse of territory between Lake Tchad or the Great Desert in the north, and Lattakoo and Kurrichane in the south. In this Utopian scheme they derived encouragement

AERONAUTIC ASSOCIATION,



CAPITAL, £8,000.

In 4,000 SHARES of £2. each—Payable in Two Instalments of £1. each

The First Instalment to be Paid on applying for Shares the Second or the whole, it is anticipated, will not be required.

1 —The Subscribed Capital it is expected will be returned to the Shareholders before the expiration of a Twelve-month and the First Profits realized in less than Six Months

2 —The Estimated Profits previous to the outset (independently of the repaid Capital) about 100 per cent

3 —The Estimated Ultimate Profits (independently of the repaid Capital) about 200 per cent.

The Aeronautic Machine will be constructed under the personal superintendence of Mr GRAHAM

Bankers.

THE LONDON AND WESTMINSTER BANK,

At any of their undermentioned Branches where Deposits for Shares may be paid

HEAD OFFICE	38 Throgmorton Street	SOUTHWARK BRANCH	11 Wellington Street Borough
WESTMINSTER BRANCH	9 Waterloo Place Pall Mall	EASTERN BRANCH	87 High Street Whitechapel
BLOOMSBURY BRANCH	213 High Holborn	ST MARYLEBONE BRANCH	155 Oxford Street

Committee,

R W CURRIE Esq	JOHN STANFORD Esq
C TOOSEY Esq	J S STEVENS Esq
CHARLES PAYNE, Esq	JOHN FURNEKFILL, Esq

With Power to add to their Number

Secretary, *(pro tempore)*,

Mr GEORGE SHEPPARD

Office of the Association,

No 112, FLEET STREET, NEARLY OPPOSITE ST BRIDE'S

FIG 82 PROSPECTUS OF THE AERONAUTIC ASSOCIATION, [MARCH 1837].

from Green's 'last voyage' to Nassau (the Weilburg voyage of November 1836), when about 400 miles were traversed in seventeen hours, from which they argued with engaging simplicity that 'it requires, perhaps, only an experiment to prove, that an aeronautic machine efficiently constructed and equipped, might proceed even over seas and oceans as safely as over countries and continents'. It need only be added that quite in the modern manner, a sum of £8,000—equivalent to the 'ultimate profit' as above mentioned—was included in the estimated balance-sheet, as a certain result of the publication and sale of the aeronauts' account of their unimaginable adventures.[1]

Hoar's 'Great Montgolfier Balloon', 1838–9.

But to return to Hoar's so-called 'Great Montgolfier Balloon'. It was made of fine lawn, red and white, covered with varnish; it measured 130 feet in height—the height of the Duke of York's column—and 200 feet at its greatest circumference, and when inflated was estimated to contain 170,000 cubic feet of air—'the largest Aerostatic Machine ever constructed in this Country'. A thin cord was sewn into each of the fifty-eight gores or seams (thus obviating the usual netting), the lower ends of which were fastened to a stout hoop, affording an aperture of 46 feet in circumference.[2] Into this neck there extended a chimney from a specially designed furnace, fed with straw, wool, and small faggots, which the inventor claimed would be capable of raising the heat of the contained air to 200 degrees Fahrenheit in three minutes, or fully inflating the balloon in eight minutes. Inflated on what was termed 'this beautifully simple, but seldom used plan', its ascending power was calculated at 2,400 lb., sufficient to lift the machine and its 15-foot wicker-work car, together with from fifteen to twenty passengers.[3]

His Failure, May 24, 1838.

The first ascent was announced to take place from the Surrey Zoological Gardens on May 24, the birthday of Queen Victoria, under whose 'immediate patronage' it was to be made—indeed the balloon was originally named the 'Queen's Royal Aerostat'. The inflation was attempted from a raised platform on an island

[1] See Prospectus of the 'Aeronautical Association' in the Cuthbert Collection (Fig. 82). It is endorsed in Fillinham's hand, 'This was Hoare's' [*sic*].

[2] The same collection also comprises fragments of Hoar's 'Montgolfière' (in which the method of sewing in the cords is clearly seen), an autograph letter, and prints of the balloon.

[3] The cost of inflation if 'simple'—and dangerous—was certainly less expensive than gas. Green's 'Nassau' balloon cost, at this time, £70 to inflate with coal-gas. The gas for Graham's ascent at Chelmsford in Aug. 1825, cost about £30.

in the middle of a lake situated in the Gardens, but it ended not only in complete failure—attributed to a miscalculation in the heating power of the furnace—but in the destruction of the balloon by an enraged mob. Even so Hoar was not wholly discouraged, and though he made even larger balloons of the same type (the third one was of 215,000 cubic feet capacity), with which he renewed his attempts from Beulah Spa, Norwood—when the ascent was to have marked the opening of the Croydon Railway—and again in April 1839 from the Racecourse at Notting Hill, complete failure, accompanied with disastrous incidents, put an end to his efforts.[1]

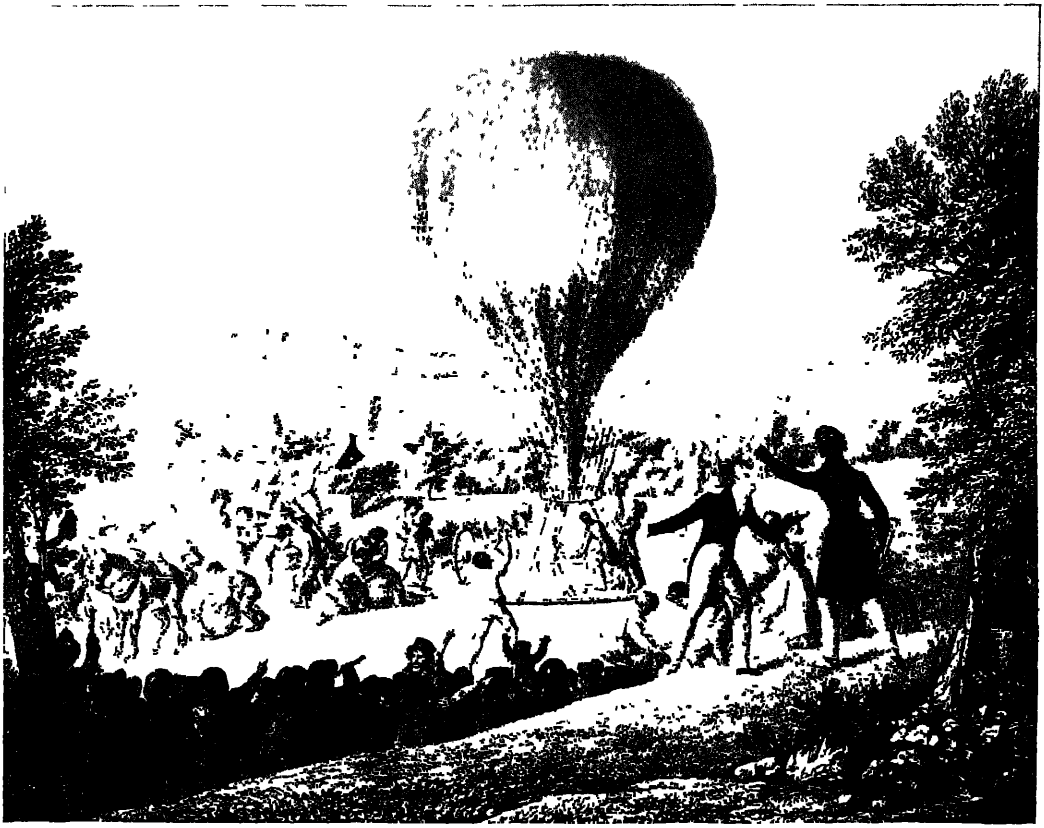
Godard's Fire Balloon, 1864.

To complete the record of 'Montgolfières' in England it may be added that in July 1864 a French aeronaut, Eugène Godard, made two ascents in an enormous fire balloon of nearly half a million cubic feet capacity. Fitted with an 18-foot stove weighing (with the chimney) 980 lb., it did not take more than about an hour to inflate. But though Godard's attempts were successful as a *tour de force*—on the first occasion the balloon came down at Greenwich and on the second at Walthamstow—the danger of ascending with a heated furnace greatly outweighed any compensating advantages, and the 'Montgolfière' type of balloon thereafter became virtually extinct for serious aeronautical purposes.[2]

But such diversions with 'Montgolfières' were exceptions to the general use of gas balloons, and were doubtless suggested rather by reason of their novelty than on account of any inherent advantages. It is true that the cost of inflation with coal-gas was a consideration which rendered the profession of the balloonist a speculative one from the pecuniary point of view. Nevertheless, though Green's position as the leading exponent of the free balloon for exhibition purposes remained secure, the attraction which balloon ascents continued to prove throughout the middle period of the eighteenth century, induced others to come forward as professional aeronauts.

[1] See Fig. 86. Hatton Turnor (p. 56), in referring to Tytler's ascent in 1784, remarks that the latter was the only one, 'with the exception of Mr. Smeath [*sic*] in 1837', to use a 'Montgolfière'. But Sadler's ascent on Oct. 4, 1784, was with a 'hot-air' balloon, while the type of balloon in which Sneath ascended from Mansfield in May 1837 is doubtful. He was said to be in the air nearly two hours, and on descending at 11 p.m. near Derby, sat in the car all night to prevent the balloon from rising again! Cf. *Penny Mechanic*, no. 32, June 1837, and MacSweeny, p. 15.

[2] *Ency. Brit.*, 11th edition, 1910–11, vol. i, p. 265. Col. Fred Burnaby in his *Ride across the Channel, and other Adventures in the Air*, 1882, describes an ascent with Godard from Cremorne Gardens, July 1864.



Representation of the balloon, immediately preceding the ascension from the Village of Seal, near Sevenoaks in Kent, the 23rd of August 1825 at six (P M), on which occasion Mr P Cornillot established the principle of sailing in an horizontal direction at any required point of elevation

FIG 83 CORNILLOT S ASCENT AT SEAL, near SEVENOAKS, AUG 23, 1825

Of these John Hampton (born in 1799), who had served in the Navy, was perhaps the most successful, and by reason of his daring parachute exploits acquired the larger measure of passing notoriety. His first adventure—which, save for good luck, might also have been his last—took place on June 8, 1838, in his own 'Albion Balloon', from the Eyre Arms Tavern, St. John's Wood. Owing to insufficient lift the balloon failed to clear the adjacent buildings, and striking the side of a house came heavily to the ground not more than 500 yards away, Hampton receiving severe injuries as a result of the fall. John Hampton's Career, 1838–51.

In June he is alleged to have entered into an agreement to ascend from the Surrey Zoological Gardens; but the proprietor, in view of the disastrous riot in connexion with Hoar's 'Great Montgolfier Balloon' on May 24, declined to carry out the arrangement, with the result that Hampton took proceedings for breach of contract and obtained a verdict with £60 damages.[1] His Ascent at Canterbury, Sept. 10, 1838.

In September the same year he ascended from Canterbury (for the third time), and again the balloon failed to rise, whereupon Hampton, tenacious like his forerunners of his reputation as an aeronaut, cut away the car, and with more temerity than discretion rose in the air seated precariously within the hoop. Twenty minutes later he came down in safety near Harbledown, and the balloon was walked back to Canterbury. The following day it was further inflated, and again walked along the roads, guided by ropes, to Margate, with Hampton seated in the hoop—a novel procedure prompted by the desire to save gas.

His subsequent descents in a parachute from Cheltenham and elsewhere,[2] doubtless increased his reputation as a daring and skilful aeronaut, and it was probably this success that led to the promotion of a ballooning company called the 'Albion Aeronautic Association', under Hampton's direction. The prospectus and financial scheme (issued for private circulation) set forth that the Association was 'constituted for the purposes of the advancement of Science in the practice of Aerostation, combining the profitable advantages arising from the various aerial voyages, partial ascents, and other aeronautical exhibitions to be made throughout the Kingdom'. But, as in the case of the earlier and much more His Balloon Company, 1837.

[1] See p. 231, *ante*. During the trial of the action Lord Abinger suggested that the case be submitted to a scientific man on the ground that 'the air is an element into which the law has not at present made any advances'. See Hampton *v.* Cross, Exchequer Court, Nov. 30, 1838.

[2] See Ch. XIV, p. 335, *et seq.*

pretentious 'Aeronautic Association', it is improbable the scheme was ever 'floated'.[1]

Hampton continued his career as a balloonist for another ten or twelve years, though with varying success. In 1844 he constructed a new balloon, with assistance from Henry Coxwell, who was disappointed (owing to insufficient lift) in not being

THE ÆRIAL MESSENGER.

FRIDAY, MAY 24th, 1839.

Printed at the Ærial Press, in the Isle of Sky, about a mile high from the Montpelier Gardens, and Pnblished at the same place by POPPOLINO PICA. Typo in Chief to the Ærial Messenger.

TRADE,
And the Public (Ærial) Funds.

City of Clouds, in the Isle of Sky.
May 24*th*, 1839

SILK is at this moment getting up very much, so are cerdages net-ting, India-rubber varnish, and various goods appertaining to Ærostation. Gas is likewise very progressively on the *rise*, but will be much lower ere long Sand is falling rapidly, therefore ballast of this kind will be extremely *light*, and there will be a considerable *fall* very shortly in Æronautic commodities generally.

The Ærial Bank has thrown out a great number of bills, and paper is at a discount, though it has been tolerably *high* in the market, whe this extraordinary run is caused by the powerful exertions of *Mr Spinney*, or the alarming exeitement of the Chartists, we cannot stop the Press to determine, at all events the holders of these bills need not consider themselves unfortunate in having them iu their possessiou, for they may be got rid of without much difficulty.

THE ÆRIAL MESSENGER,
Friday, May 24*th*, 1839.

" All mankiud to some lovod ills
[incline,
Great men choose great sins,—
Ascending's mine !"
Shakspeare improved.

BELOVED READERS,

Custom has deemed it necessary in all periodical journals to have a *leader*,—we therefore obey its mandate, but ours will not be of a political kind (we Ærial editors write in the plural be it understood, as well as ye earthly scribes) no, for we belong to *no party*, "but open to all, and influenced by none"—

Fig. 84.

able to accompany Hampton on the first ascent from Birmingham. On August 19, however, Hampton took him up as a passenger under the name of H. Wells—a pseudonym adopted for fear of displeasing his friends—from White Conduit Gardens, Pentonville, and after twenty-five minutes of what Coxwell called a 'tantalising short-lived piece of grandeur', a safe landing was made at East-ham

[1] Hampton's enterprise also took the form of printing in diminutive (24 mo) form, '*The Aerial Messenger*. . . . Printed at the Aerial Press in the Isle of Sky', which he doubtless distributed from his balloon (Fig. 84).

FIG 85 JOHN HAMPTON
First English Parachutist

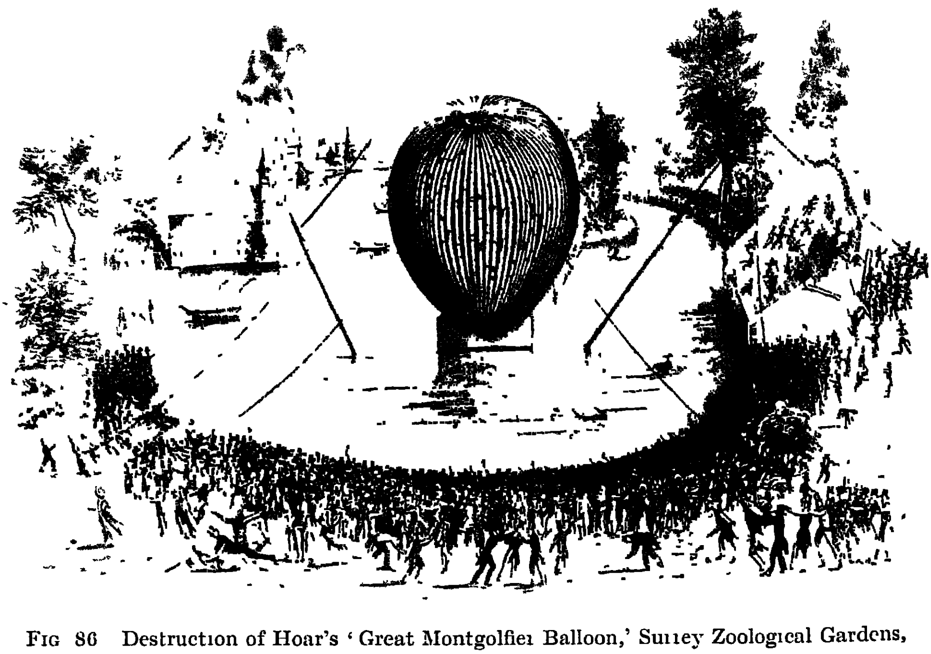


FIG 86 Destruction of Hoar's 'Great Montgolfier Balloon,' Surrey Zoological Gardens, Walworth, May 24, 1838.

Hall. Shortly afterwards Hampton undertook a tour in Ireland, but had the misfortune in Dublin to descend on a house-top, when his balloon was completely destroyed by fire, the aeronaut escaping without harm. With the aid of subscriptions he made a larger balloon—second only in size to the 'Royal Nassau'—which he appropriately named the 'Erin-go-bragh', and in which he made a successful ascent from Dublin on October 7, 1844. A feature of this balloon was a new form of valve, capable of being opened only an eighth of an inch or to its fullest extent, at the will of the pilot—an improvement (so claimed) on the older form of shutter valve, and one designed to facilitate a gradual and easy landing. By the year 1851 he had made 119 ascents, but though his interest in his profession—and it may be added the aggressive rivalry he displayed throughout his career against Charles Green—continued, and found expression in letters to the press on 'Dangerous Attractions' and 'Ballooning Cruelties', Hampton retired from active ballooning within a year or so.

Richard Gypson (fl. 1839–49).

The career as a professional balloonist of Hampton's contemporary, Richard Gypson (born in 1811), covered about ten years between 1839 and 1849, and except for inevitable experiences of an exciting character was not otherwise remarkable. In June 1839 he made a nocturnal ascent from City Road accompanied by a descendant of the famous French balloonist, Blanchard, who was described on the announcements as 'the Inventor of the Parachute'. Gypson's 'Royal Standard' balloon was made of the 'richest silk' of crimson and gold, and with a circumference of 118 feet it had a capacity of 20,000 cubic feet.[1] His ascents were mostly undertaken from the vicinity of the gas-works of market towns in the midland and eastern counties, usually with the additional, though by no means novel, attraction, of dropping a small parachute 'containing a living animal'.

Perilous Ascents, 1847–9.

Gypson's most notable experience was that of July 6, 1847, when with three companions (including Henry Coxwell and Albert Smith, the author of *The Adventures of Mr. Ledbury*) he narrowly escaped death owing to the bursting of the balloon.[2] In October 1849, having by this time earned a reputation as a 'celebrated aeronaut', he completed his 100th ascent, made from Bedford in the

[1] Gypson advertised on posters of his second ascent (May 13, 1839) that the balloon inflated 'with Hydrogen Gas, will carry 8 persons', but there is no reason to believe he ever used hydrogen.

[2] See Henry Coxwell's account in Ch. XII, p. 265, *post*.

'Royal Albert' balloon. The experience seemed likely at one time to prove as hazardous as any he had hitherto faced, for at about 15,000 feet it was found that the neck of the balloon—unwisely tied up before leaving the ground 'to prevent the admission of atmospheric air'—was frozen hard, while the valve was likewise frozen and could not be opened.[1] As the gas had expanded fully owing to the altitude and the sun's rays combined, Gypson, with admirable promptitude, climbed into the hoop and cut a large incision in the envelope, thus allowing some escape. Subsequently a safe descent was made near Otmoor in Oxfordshire, the distance of fifty-nine miles from Bedford having been covered in forty-four minutes.

Gypson did not effect any technical improvement of a practical value in the balloon, though he experimented with two or three new devices. It was said that in an ascent made from Birmingham in September 1840 he used a new type of valve, designed to facilitate landing, his confidence in which was so complete as to lead him to regard 'the grappling iron and cable as unnecessary incumbrances'. But it did not save him—if indeed, he continued to use it—from an unpleasant experience at Dublin in June 1843, when he missed a landing on the beach and fell into the sea off Bray Head, to be rescued in an exhausted condition after being twenty minutes in the water.

After 1849, having given up ballooning—probably for financial reasons—Gypson appears to have fallen on evil days, during which he eked out an existence as a writer of doggerel poetry. His last recorded public appearance in May 1853 was far from being an elevated one—he was charged in the City and found guilty of stealing pewter pots from various publicans, and was only released (after an hour's imprisonment) owing to some doubts as to his sanity.[2]

Lieut G. B. Gale, R.N. (1794–1850).

A balloonist with a measure of inventive ability was George Burcher Gale, born at Fulham, Middlesex, in May 1794, who in early life achieved success in the theatrical world. In 1831 he visited America, and is said to have played the part of 'Mazeppa' for 200 nights at the Bowery Theatre, New York, in which city he became acquainted with M. Arnaud Robert, a professional

[1] Contemporary accounts state that the barometer at starting stood at 28·2–10, and at the highest altitude at 14·1–10.

[2] The foregoing details of Gypson's career—as also those in the following account of Gale—are mostly taken from cuttings, posters, &c., in the Cuthbert Collection.

FIG 87 GEORGE BURCHER GALE

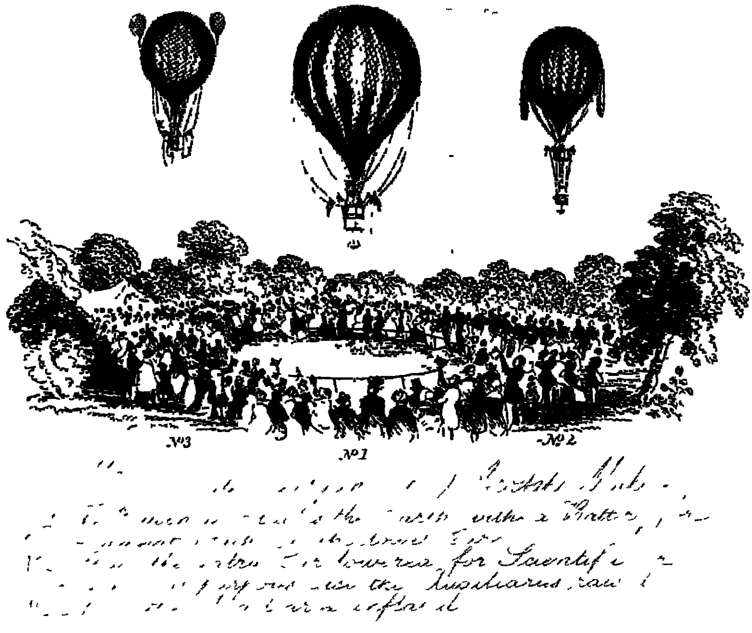


FIG 88 GALE'S AEROSTATIC MACHINE, 1847

aeronaut, and with him made several ascents. Returning to England he entered the Navy and served as inspector in the Coast Blockade Service in northern Ireland, a post which he relinquished as uncongenial. Finding that conditions in theatrical circles had changed during his absence, he took up ballooning, to improvements in which he claimed to have devoted much time and study since his visit to America.

His 'Newly Invented Aerostatic Machine', 1847.

Realizing (as many others have done, both before and since) the limitations of the balloon, resulting from the expansion and consequent loss of gas at high altitudes, he designed and constructed a balloon which embodied devices designed to obviate the difficulty. His so-called 'Newly Invented Aerostatic Machine' consisted of an ordinary balloon of about 40,000 cubic feet capacity, to the neck of which were attached two tubes, which carried off the overflow gas. These tubes led up to two auxiliary balloons—13 feet in diameter—affixed to the periphery of the main envelope, which, hanging flaccid during the first ascent, became inflated as the balloon rose above the point of equilibrium. Gale believed this device would enable him to ascend to a higher altitude than had been hitherto achieved, and that during the descent the gas from the auxiliaries would return to the main balloon.

An equally novel though otherwise purposeless improvement consisted of a dual car, one fitted within another, and made of cork cemented with marine glue and covered with canvas. When in the air the outer one was capable of being lowered 20 or 30 feet by means of rope tackle, 'a communication of ratlines, shrouds and staylines affording the Aeronaut the means of safe transit between the two cars'. This arrangement can have had no other advantages than of affording Gale an opportunity of performing the sensational feat of passing in mid-air from one car to the other, and of allowing a comparatively safe display of fireworks from the lower one.

His First Ascent from Peckham, Apr. 7, 1847.

The first ascent—to which Gale publicly invited 'persons of scientific character'—took place from the Rosemary Branch Tavern, Peckham, on April 7, 1847. When at an altitude of about 5,000 feet, Gale climbed down into the lower car and back again without incident; but shortly afterwards, on releasing gas, the spring valve failed to return to its seating, with the result that the balloon fell with alarming rapidity. The descent was, however, checked, and a landing effected without danger, though in view

of it, Gale discarded his 'spring valve', of which Coxwell had disapproved, and on account of which he had refused to accompany Gale on this occasion. Subsequently, however, he made several ascents with Gale, during one of which (in May 1847) they had a narrow escape on landing in a high wind near Stroud in Gloucestershire, the balloon striking a large oak tree, when both aeronauts were thrown heavily to the ground.[1]

Accident at Glasgow. July 1847

A 'repeat' ascent, attempted at Glasgow in July, was in some ways more disastrous, for the balloon broke away in a high gust of wind during inflation, and though subsequently recovered near Alnwick, in Northumberland, Gale was involved in heavy expense. For the next two or three years he continued to make ascents, his 103rd being accomplished from Cremorne Gardens in July 1850. In October 1849 he had suggested that balloons might usefully be employed with the Arctic expeditions sent in search of Sir John Franklin, a scheme which he pressed with enthusiasm and in which he offered his services as aeronaut.[2] But in striving (for the sake of pecuniary gain) after sensational effects—as, for example, when he ascended with a lion from Cremorne Gardens in September 1848—it must be admitted that he did more to discredit ballooning than he achieved by his inventions in the direction of improvement. Indeed his death indirectly resulted from a foolhardy feat undertaken for spectacular show. He appears to have crossed the Channel from Cremorne Gardens on July 8, 1850, and on September 8 following (during a tour in France) he ascended from the Hippodrome at Vincennes, at Bordeaux, seated on a pony slung beneath his 'Royal Cremorne' balloon. On landing, his lack of a knowledge of French led to a misunderstanding with the peasantry who came to his assistance, with the result that the balloon was suddenly released—after the pony had been freed—and rose with Gale clinging to the ropes of the car. Unable to retain his hold, the unfortunate aeronaut must have fallen from a great height, his body not being found until some days later, at a considerable distance from the balloon.

His Death at Bordeaux, Sept 8, 1850

[1] Gale's balloon was so damaged as to be useless for a further engagement at Hoxton two days later. Gypson, however, was in the neighbourhood, and he not only generously lent his balloon to his rival 'brother aeronaut', but ascended with him.

[2] Gale approached the Admiralty on the subject, but was met with the official cold shoulder. A press campaign followed, with little result, save to call forth the ridicule of *Punch*. Finally he started, with G. A. Sala as his partner, on a lecture tour to explain his views, but the first meeting at Hull proved a dismal failure, and he then gave up. See Sala (G. A), *Life and Adventures*, 1896, pp. 236–9. Also *D.N.B.*, vol. 20, 1889, p. 373.

Less than two years later a similar fate overtook James Goulston, who had on several occasions ascended with Gale, and who (with his son) had joined Gale as a partner on his tour in France. Goulston was a manufacturer of oil-cloth in the Old Kent Road, and having adopted ballooning as a professional pursuit, he undertook public ascents at places of amusement throughout the country. His fatal ascent—the fifty-first—was made from the Bellevue Gardens, Manchester, on June 2, 1852. The balloon was a new one made by Goulston—who in his ascents from Cremorne Gardens had adopted the professional title of Signor Giuseppe Lunardini—and had a capacity of 23,000 cubic feet. In view of the rough weather—heavy rain and sudden squalls—Goulston was advised to defer his ascent, but declining to disappoint the assembled spectators, the balloon rose slowly (owing to the car and the netting having absorbed so much water) and was soon lost in low-lying clouds.[1] On attempting to land in the bleak country round Stone Breaks Hill, near Oldham—about eight miles north-east of Manchester—Goulston appears to have been thrown out, when, with a sudden jerk, the grapnel struck a low stone wall. Unfortunately his feet caught in the network of the car, and in this utterly helpless condition, head downwards, the wretched aeronaut was dragged across several fields, to be finally dashed against the side of a house. At this point the balloon—still fully inflated—was secured by the villagers, but too late to rescue Goulston, who had expired before he could be released from entanglement with the car.[2]

James Goulston (1801–52).

His Death near Manchester, June 2, 1852.

This 'chapter of accidents' may fitly conclude with one other adventure of the 'fifties' which is of some interest, and which occurred during the ascent of a balloon piloted by Lieut. Chambers, another popular aeronaut of the period.[3] It took place early in

Lieut. Chambers, R.N. (fl. 1851–4).

[1] Goulston was to have been accompanied by a young man named Jennison, but the lift was insufficient to carry a passenger. This was Goulston's first 'solo' ascent, and he had told his son (who was also an aeronaut) that in any difficulty on landing he should jump from the car and let the balloon go free.

[2] See Cuthbert Collection, which includes an autograph letter from Goulston relating to this ascent, and one from his son which testifies to the esteem with which his father was regarded.

[3] Nothing is known of Chambers save his aeronautical exploits. In October 1852 'the celebrated Capt. Chambers, R.N.' piloted the 'Prince of Wales' balloon from Cremorne Gardens. In July 1854 'the Veteran Aeronaut, Lieut. Chambers, R.N.', ascended from Camberwell. His son (who also made ascents from Cremorne Gardens and elsewhere) was killed on a solo flight from Nottingham in Coxwell's balloon, August 1863. Rendered insensible by gas escaping from the appendix, he collapsed with the valve-line in his hand, thereby deflating the balloon, which crashed to earth.

September 1851 from the Symposium (or restaurant) of the famous cook, Alexis Soyer, at Kensington—an appropriate starting-place, seeing that George Augustus Sala (1828–96), who styled himself at this time 'a poor caricaturist', was one of the three passengers, the others being a Mr. Gardiner and the aeronaut's own son. When at a considerable height over Fulham the balloon burst with 'a report like that of a musket', and (as Sala put it) for some forty seconds the four men, crashing to earth with frightful rapidity, stared death in the face. It is clear that the disaster was due to the imprudence or inexperience of Chambers in having tied a silk handkerchief round the neck of the balloon. On the other hand, Sala generously admitted that the prompt action of Chambers—'an old man, but brave as a lion'—in cutting the neck-line and allowing the balloon to act as a parachute, not less certainly saved the lives of the party, for the landing, though violent, did not result in any serious injuries.

G. A. Sala's Protest against Ballooning.

Such an alarming experience, brief as it was, may well have made an impression on Sala—then a young man of twenty-three—and the realistic account he subsequently sent to *The Times* revealed his latent talent for journalism. At the conclusion of a vivid description he added, with a touch of inconsistency—for which he sought excuse as being an 'enthusiast in aerostation as a science'—a 'solemn protest against the whole system of ballooning as at present existing'. 'If', wrote Sala, 'any beneficial result was to be looked for—if any scientific ends were to be gained by balloon ascents, I should be silent; but it is madness and folly to permit any enthusiast or charlatan who may be the possessor of a silk bag which he can afford to fill with coal-gas, to risk his own life among the clouds, as well as those of the madcaps who are with him, for the amusement of some hundreds of gobemouches who have paid a shilling a head to see their fellow-creatures commit constructive suicide. Whether he and his companions come down in safety, or are sent, unprepared and unshriven, into the presence of their Maker, the risk is still the same—the utter uselessness and folly of the thing remain intact.'[1]

[1] Of one other aeronaut in this period who narrowly escaped death, little is known save his name, Livingstone, and his few ballooning exploits. Three years after his ascent with Windham Sadler from Liverpool (p. 156, *ante*), he went up from Dublin on June 27, 1822, and fell in the sea off the coast of Baldoyle—an incident depicted in a fine coloured aquatint engraved by R. Havell after T. J. Mulvany. In September the same year he ascended from Preston and when landing was thrown out of the car from a height of 15ft., but escaped with severe bruises.

CHAPTER XI

CHARLES GREEN, 1785–1870

THE period covering the three decades prior to 1850 despite considerable activity, was not of special interest from the point of view of the development of the balloon as an aeronautical machine. Nevertheless, some prominence must be allowed to the name of Charles Green, if only by reason of the extent of his experiences as an aerial pilot. Though he was not, strictly speaking, a scientific aeronaut, and although (save in the introduction of coal-gas) he made no material contribution to the knowledge of lighter-than-air navigation, Green's record of over 500 ascents accomplished between 1821 and 1852 (in the course of which he must have travelled between 10,000 and 15,000 miles through the air), won for him a unique place in the history of ballooning. Moreover, the fact that his aeronautical experiences were perforce confined to the barren limits of the free balloon, should not impair the reflection that in Green's day hopes were still entertained that the utility of the balloon would prove capable of increased scope, whereas flight by mechanical means was at that time commonly regarded as hopeless. Indeed, up to the time of his death the aerostatic principle of the balloon had alone enabled man to travel through the air—and in later times this same lighter-than-air principle has made possible the trans-oceanic voyages of large airships.

Born Jan. 31, 1785.

Charles Green was born in Goswell Road, London, on January 31, 1785—two years after the invention of the balloon. He was of humble origin, his father being a fruiterer, which business the future aeronaut joined on leaving school.[1] It is said that Green's attention was first directed to aerostation as the outcome of experiments he tried with an apparatus for making gas, by means of which he proposed to light his own premises. He observed that the first distillation gave the best results for illumination, and that towards the end of the process the flame was scarcely visible. 'Suspecting'—to quote from the obituary notice of Green in

[1] *D. N. B.*, vol. xxiii, p. 41.

the *Fourth Annual Report of the Aeronautical Society*—' that this must be nearly pure hydrogen, he inflated some small balloons with the gas obtained at various stages of distillation '.[1] The results proved in a simple, practical way—characteristic of Green's methods—that the gas obtained in the early stages of the process was heavier than that given off towards the end, a fact which, in his later aeronautical career, he usually impressed upon the managers of the gas-works where his balloons were inflated.

His earliest advertised ascent was arranged to take place from Belvidere Gardens, Pentonville, On July 18, 1821. Having demonstrated by actual experiments before the ' Gas-Light Company ', and ' other Scientific Characters ', that their gas was of sufficient levity for ' all the purposes of Aerostation ', he constructed at considerable expense a balloon 31 feet in diameter, with a capacity of 100,000 gallons, capable of raising 8 cwt.[2] For some unknown reason this ascent did not take place, but Green was engaged by the Government to ascend the next day from the Green Park, on the occasion of the coronation festivities. The inflation of the balloon—which was decorated with the royal arms, and inscribed ' George IV, Royal Coronation Balloon '—was effected from the gas-main in Piccadilly, and on being released it rose to about 11,000 feet. Carried by a veering westerly wind and fearing that he might fall in the sea, Green valved a considerable quantity of gas, with the result that after about forty minutes he descended so rapidly into a field beyond Barnet, that he was thrown out and subsequently dragged along the ground for nearly a quarter of a mile holding to the hoop.

His First Ascent, St. James's Park, July 19, 1821.

His Use of Carburetted Hydrogen (Coal-gas).

The ascent was not remarkable save for the fact that the balloon was inflated with coal-gas, this being the first occasion on which it was successfully used for ballooning purposes.[3] Green's own account of his exploit stated that the balloon contained ' about

[1] *Aer. Soc. Fourth Report*, 1869, p. 89. No authority is given for the statements as to Green's gas-making experiments, which are not referred to elsewhere. The manufacture of gas for street lighting in London began about 1807.

[2] A hand-bill announced that the ascent was under the patronage of the company. Special attention was called to the fact that the inflation being made from the main gas-pipe, ' all accidents to Ladies' Dresses, &c.', from the action of acid (as used in the production of hydrogen) would be avoided (Fig. 89).

[3] Cf. MacSweeny (p. 77), where it is said that ' M. Thysbaert filled a balloon with coal-gas at Louvain in 1784 (*Monthly Review*, vol. lxxi, p. 381), and that ' Mr. Bland in 1816 again proposed it '. Cavallo (p. 235) recommended this gas for aerostation in 1785.

1,200 cubic feet of carbonated hydrogen gas', and that he took some credit for the introduction of this method of inflation—which

MAGNIFICENT

BALLOON

MR. GREEN

HAS the honor to inform the Nobility, Gentry, and Public, that he has, at considerable Expense, constructed a SUPERB BALLOON, of sufficient Capacity to contain One Hundred Thousand Gallons of Gas, and capable of raising into the Atmosphere Eight Hundred Weight, with which he will ASCEND from the

BELVIDERE GARDENS

PENTONVILLE,

On WEDNESDAY the 18th JULY, 1821

UNDER THE PATRONAGE OF THE ORIGINAL CHARTERED

GAS-LIGHT COMPANY,

Mr. G. having clearly demonstrated to them, and other Scientific Characters, by actual Experiment, that their Gas is of sufficient Levity for all the Purposes of Ærostation.

As this Stupendous BALLOON will be inflated by a large Pipe from the Company's Main, all Accidents to Ladies' Dresses, &c. from the action of Acid, will be avoided.

Single Tickets of Admission, 5s., Double ditto, 9s. each, may be had of Mr. GREEN, No. 49, Goswell Street; Mr. BARHAM, Oxford Market; and at the BELVIDERE TAVERN.

Mr. GREEN purposes to ascend precisely at THREE O'CLOCK IN THE AFTERNOON, and therefore respectfully solicits the early Attendance of those Ladies and Gentlemen who intend to honor him with their presence.

Fig. 89.

was clearly an improvement—is revealed in the reiteration of his invention in the announcements of ascents for many years to come.[1]

[1] The use of the term 'carbonated hydrogen' (i. e. 'carburetted hydrogen', or 'coal-gas') is unusual, and may be due to Green's lack of chemical knowledge. He appears to have used hydrogen on one occasion only, viz. on his ninety-eighth ascent at the Swan Inn, Stratford—presumably because coal-gas was not available.

At a later date he published his reasons for the adoption of coal-gas in preference to hydrogen, which (originally set out in ten paragraphs) may be summarized as follows:

(1) Coal-gas is less injurious to the silk envelope.
(2) It renders the inflation of the balloon a quicker and more certain operation.
(3) It is not so penetrating, i. e. does not diffuse as quickly through the envelope.
(4) It is much cheaper than hydrogen (Green computed that at this time the cost of 6 inflations with coal-gas was not more than 1 with hydrogen).

Second Ascent, Aug. 1821.

Green's second ascent took place from the Belvidere Gardens early in August, and after a trip of '20 minutes precisely'—throughout his career he showed unusual care in observations on his experiences—he descended near Barking in Essex, with which fact he at once proceeded to acquaint Mrs. Green through the medium of a carrier pigeon taken in the car. In October of the same year he made an ascent from Brighton, the balloon falling on the water about four miles out to sea, when Green was rescued by a passing packet boat.[1] In July 1822 another misfortune overtook him at Cheltenham, where he ascended with a local journalist named Griffith, of the *Cheltenham Chronicle*. Just before the ascent it was noticed that some malicious person had cut one of the ropes by which the car was suspended, whereupon to avoid risk of further damage Green immediately gave the order to let go. On descending near Salperton, only seven miles away, the grappling iron failed to hold, and the car was dragged over fields and through hedges before becoming fast in a tree. The balloon then broke away, and Green and his companion were thrown heavily to the ground, both sustaining serious injuries. Possibly these losses account for the fact that apparently he made no further ascents until June 1823, when he went up from Oxford with an ironmonger of Bishopsgate Street, London, Isaac Earlysman Sparrow, who paid £50 for his venture. Green's early ill-luck—doubtless due in a large measure to inexperience—still followed him, for the car on rising struck one of the chimneys of the gas-

Falls in the Sea off Brighton, Oct. 1821.

At Cheltenham, July 1822.

Oxford, June 13, 1823.

[1] Apparently this is the occasion to which Monck Mason (p. 91, note) refers as Green's 'fifth ascent, wherein he had the misfortune to lose his balloon . . . in the sea off Beechy Head'. In the Cuthbert Collection a small water-colour of the incident gives the date as Oct. 14, 1821.

works, and a violent landing near Henley—in which Sparrow was thrown out—resulted in Green finding himself for the second time lodged in a tree.[1] Other ascents followed in 1823—from the vicinity of Leeds, when Green was once more thrown out on landing near Gainsborough; at the Mermaid Tavern, Hackney, this being advertised as his seventh ascent, and at Reading, on which latter occasion the balloon landed gently near North Mimms, about forty miles away.

From 1823 onwards Green's activities and reputation as a professional balloonist steadily increased, and by July 1835 he had made over two hundred ascents, a large proportion of them from provincial and market towns throughout the country. His fiftieth ascent was achieved in April 1826 from the Golden Eagle, in the Mile End Road; in July of that year he made (from Vauxhall Gardens) his first night ascent—a feat Garnerin was probably the earliest to perform on August 4, 1807; a year later he attained (at Maidstone) his highest altitude up to that date, about 13,000 feet; on July 29, 1828, he went up from the Eagle Tavern, City Road, mounted—for the third time—on a small pony, and descended safely at Beckenham, in Kent; while on August 1, 1831, he ascended from near London Bridge on the opening of the new structure by William IV.[2] Most of the ascents were advertised as being undertaken with the Coronation Balloon, described in the earlier announcements as made of alternate gores of blue, crimson, and gold silk, measuring 107 feet in circumference, and with a capacity of 136,280 gallons of gas.[3] In the spring of 1825 Green gave up advertising these dimensions as superfluous, 'the Public having been annoyed so much of late respecting the *size* and *capacity* of other balloons'. Nevertheless while admitting his own to be the smallest one in use, he undertook to accomplish with it as much as had been claimed for 'the ascents (or pretended ascents) made with such immense large ones'. **Ascents during 1823–5.**

In July 1826 he had an 'entirely new' balloon, though of the **1826–35.**

[1] In commemoration of his ascent Sparrow struck three small medals or tokens, for an account of which see *Aeronaut. Journal*, October 1901, p. 64 (cf. *I. L. A.*, nos. 538–9). He also issued—probably for advertising purposes—small circular prints of a balloon bearing his name, with the words 'Nails and Sauce, Bishopsgate'.

[2] Pierre Testu-Brissy (at Meudon, Oct. 16, 1798) appears to have been the first to make an equestrian ascent. See Bruel, no. 173 and Lockwood Marsh, no. 78. Many contemporary engravings, showing Green's balloon, were done of the opening of London Bridge—notably a fine aquatint by Havell.

[3] Bearing in mind his earlier losses Green presumably retained the name 'Coronation' as favourably associated in the public mind with his first ascent.

same capacity, and with it his exhibition ascents were continued with uniform success. Indeed, by 1829 he had become known as the 'celebrated aeronaut', and three years later Green himself claimed that owing to improvements in the grappling iron and in the balloon—achieved after much trouble and expense—he had converted the balloon into a machine of almost perfect safety. As a rule his ascents were made in the afternoon or early evening, and they seldom lasted more than an hour or so, the average distance covered being probably not more than twenty-five or thirty miles.[1] A notable exception was a voyage from Vauxhall Gardens in September 1835, when he ascended with a surgeon named Butler. On landing at Walthamstow Butler got out, but Green reascended and remained in the air all night, landing for a second time at Downham in Norfolk. After partaking of breakfast he again went up and finally came down at Lynn, after having been in the air for thirteen hours, during which time the balloon had travelled 130 miles or more.

Novel Exhibition Ascents.

Though Green's ascents during this early period—between 1821 and 1835—continued to draw the public, he evidently found it desirable to vary the programme by novel exhibitions. These novelties took the form of releasing small parachutes containing a monkey or other live animal; night ascents, to which was added later the dangerous attraction of fireworks (let off from beneath the car); and double ascents, when Green engaged in so-called races with one or other of his three brothers, William, Henry, and James. Doubtless it was owing to the attraction afforded by Green's reputation as a balloonist since about 1831, that led Gye and Hughes, the proprietors of Vauxhall Gardens, to finance in 1837 the construction of a balloon of large dimensions. Its completion was the opening of a new phase in the life of Charles Green, whose name is usually associated with the balloon in which he made probably the greater number, and certainly the most famous of his aerial voyages.

The Royal Vauxhall Balloon, Sept. 1836.

The Royal Vauxhall Balloon, as it was originally called, was constructed under Green's sole direction though at the cost of the proprietors, and after many months of anxiety and labour was completed in August 1836. The announcements of the first ascent as arranged for September 9th, included a description of its

[1] On July 20, 1835, Green made his 200th ascent, and (according to Monck Mason, p. 298, note) he was able to fix 6,000 miles as the total distance travelled up to that date, in an aggregate of 240 hours.

dimensions and capacity, which are presumably authentic and may be quoted at length.

'The Balloon is 157 Feet in circumference; and the extreme height of the whole, when inflated, and with the car attached, will be 80 Feet. It is formed of 2000 yards of crimson and white silk, imported in the raw state from Italy, expressly for the purpose; and is dyed by Messrs. Jaques, and manufactured by Messrs. Soper, of Spitalfields. The method of uniting the gores (the invention of Mr. Green) is by a cement of such a tenacious nature, that when once dry, the joint becomes the strongest part.[1] It contains 70,000 cubic feet of gas. The weight of atmospheric air sufficient to inflate it, is about 5,346 lbs.; and that of the same quantity of pure hydrogen gas, about 364 lbs.; the Machine would consequently, if inflated with that gas, have an ascending power of 4,982 lbs.; and allowing 700 lbs. for the weight of silk and apparatus, and 362 lbs. for ballast, would be capable of ascending with 28 persons of the average weight of 140 lbs. each. But Mr. Green in his first experiments in Aerostation, seeing the great expense, difficulty and inconvenience of using pure hydrogen gas, conceived the possibility of substituting carburetted hydrogen or coal gas, such as is used for illumination; and proved the truth of his assertion by ascending with his Balloon inflated with it from the Park, on the day of the coronation of his late Majesty George IV. From that time the use of pure hydrogen has been almost, if not entirely, discontinued, the expense of generating it being six times greater than that of coal gas. The specific gravity of coal gas being considerably greater than that of hydrogen, it gives a Balloon a much smaller ascending power; and the quality of coal used, and the methods employed by different gas companies in its manufacture are so various, (the specific gravity having been found to vary from 340 to 790) that it is impossible to ascertain exactly what would be the power of a Balloon inflated with it. It is, however, calculated that the new Balloon will ascend with from 8 to 10 persons, besides ballast and apparatus; the power varying according to the quality of the gas, the state of the atmosphere, and a variety of causes. As a matter of curiosity, it may be stated, that the inflated silk will sustain an atmospheric pressure of 20,433,600 lbs. or 9,122 tons. The net which entirely envelopes the silk is of hemp, and the car of basket work; the grapple or anchor, is of wrought iron, and will be attached to an elastic Indian rubber cord from the factory of Mr. Sievier. This will prevent in a very great measure, any sudden jirk in stopping the Balloon in rough weather, whereby so many accidents have occurred.

[1] See *London Mechanics' Register*, vol. iii, 1826, p. 252 (Tatum's Lecture on Aerostation), where it is said that the silk thus cemented 'gave way sooner in any other part than where it was joined', but that Green was 'over-persuaded to take the additional precaution of having them stitched'. There is, however, a fragment of joined silk in the Cuthbert Collection which is cemented only. Cf. Wing-Commander T. R. Cave-Browne-Cave's remarks on the detrimental effect of stitching seams in airship fabrics (*Aeronaut. Journal*, vol. xxv, 1921, p. 351).

'Among the many advantages to be gained from the enormous increase in the dimensions of this Aerostatic Machine, are the following:—A much greater elevation will be attained than hitherto has been, and the long-agitated question decided as to whether there are, at a great altitude currents of air proceeding in one direction for several months together. This, Mr. Green, from many observations he has made, believes to be the case at an altitude, where the atmosphere is not acted on by the reflection of the sun's rays from the earth, or dense masses of clouds. Should this theory be found correct, a grand step in the progress of Aerostation will be made. The great power of the Machine, even when inflated with coal gas, will enable scientific gentlemen to ascend with philosophical apparatus, for the purpose of making experiments on Electricity, Pneumatics, Magnetism, &c., or Astronomical Observations, which from the small dimensions of all other Balloons, has been impossible; and this circumstance has caused them to be regarded by scientific men as mere objects of public exhibition.' [1]

It may be added that the wicker-work car was oval in form, about 9 feet long by 4 feet broad, decorated at either end with a gilded eagle's head, and was suspended in the usual way by ten ropes to a hoop 6 feet in diameter.[2]

The First Ascent, Sept. 9, 1836.

The first ascent took place from Vauxhall Gardens on the day appointed, Lord Palmerston, Count D'Orsay, and 'the veteran aeronaut Mr. [John] Sadler' being amongst the spectators, while great crowds witnessed the event—free of charge as of old—from both banks of the Thames and from neighbouring points of vantage. The inflation—which cost about £70 for the gas—was begun soon after 11 o'clock, and in an hour's time the 'lift' was so great that despite the use of forty-one weights of 56 lb. each, the thirty-six policemen who had hold of the cords connected with the net-work were obliged to pass their staves through the meshes to prevent the cords cutting their hands. Eventually the assistance of twenty workmen in the Gardens had to be obtained in order to hold the balloon down. Owing to the improved purity of the gas Green considerably underestimated the 'ascending power', and was obliged to valve 15,000 feet (equal to one-fifth of the power of the whole) before ascending, and that in spite of the fact that he carried twenty-four bags of ballast weighing 400 lb. Heavy rain necessitated adjustments in the suspension of the car and delayed the ascent until about 6 p.m., when Green and his wife, his brother

[1] Hand-bill announcing the first ascent (see Cuthbert Aeronautical Collections, vol. 3, Chas. Green).

[2] A full description of the Vauxhall balloon also appeared in *The Mirror*, vol. xxviii (Sept. 17), 1836, pp. 178–81.

Fig 90 THE 'VAUXHALL' OR 'NASSAU' BALLOON OVER THE MEDWAY 1837

James, Robert Hollond, M.P., and five other passengers, making nine in all, having entered the car, the immense balloon 'rose in splendid majestic style, amidst shouts of approbation'. Rising above the heavy prevailing clouds into bright sunshine, the balloon in less than five minutes attained to about 13,000 feet, whereupon Green, prompted by the darkness, prepared to descend, and a safe landing was made near Cliffe, a village about five miles beyond Gravesend, the trip having lasted less than an hour and a half.

Second Ascent, Sept. 26, 1836.

The original car having proved inadequate, a larger one capable of carrying twelve passengers was fitted for the second ascent, which took place on September 21st. Before the start Green tested the power of the balloon (which he had been unable to do on the first occasion owing to weather), his own calculations of the weights involved being made up as follows: silk and valve, 338 lb.; net, 224 lb.; car, 200 lb.; hoop, 85 lb.; liberating iron and ropes, 30 lb.; grappling line and grapple, 120 lb.; total 997 lb. Having filled the car with nineteen men—as many as it would hold—Green, sitting on the edge, ordered the ropes to be paid out, and the balloon raised the entire weight, amounting to 3,797 lb. Subsequently a short trip was made in perfectly calm weather with eleven passengers, including Edward Spencer, a solicitor of Barnsbury who was a personal friend and colleague of the aeronaut, and for whose youngest son, Charles Green Spencer, Green stood as godfather. In his subsequent career as an amateur aeronaut Spencer made about forty flights, but his name is of greater interest by reason of the place subsequently taken by several generations of the Spencer family in the annals of ballooning and aeronautics in England.[1]

Third Ascent, Sept. 27, 1836.

A third ascent followed on September 27th, Thomas Monck Mason—described at that time as a 'person of some celebrity in the operatic world'—being one of the eight passengers. As Monck Mason subsequently attained repute in aeronautical matters—especially in connexion with the Weilburg voyage—it may be stated that he was the only son of W. Monck Mason of Stillorgan, Co. Dublin, and was born in 1803. Having studied music—it is

[1] C. G. Spencer devoted himself more seriously to aeronautics than his father. In 1867 he joined the Aeronautical Society; in the year following he took out a patent for a flying machine (Abridgements, 1868, no. 1178) with which he claimed to have been able to 'jump' or glide about 120 feet (*Aeronaut. Soc. Third Report*, 1868, p. 49. Cf. Catalogue of First Aeronaut. Exhibn. 1869, p. 8), and he was the founder of the firm of C. G. Spencer & Sons of Highbury, manufacturers of balloons, parachutes, &c.

said he was a fine flute player—he became interested in the opera, and was at one time lessee of Her Majesty's Theatre. After his ascents with Green he devoted considerable attention to aeronautics, and was widely known as the author of *Aeronautica*, 1838—being an enlarged edition of his account of the expedition to Weilburg written in the previous year, with the addition of notes on the principles of ballooning and on directing balloons. In 1843 he designed and constructed a model dirigible airship propelled by clockwork, of which he published an engraving (Fig. 122). His death occurred in September 1889. Another passenger on this occasion was Robert Cocking, whose name was to be tragically associated with the Vauxhall balloon less than a year later. Owing to a fresh breeze the balloon travelled about thirty miles in fifty-five minutes, and a safe landing was made near Chelmsford. During the flight Green gave (as he believed) a fair trial to an elastic india-rubber rope attached to the grapnel, which caught firmly in a hedge after dragging across three fields, the resulting jerk being 'scarcely perceptible' and the landing as easy as in a calm. Two further ascents were made on October 6th and 17th, and though otherwise without incident, the latter is of note as a joint aerial excursion by Green, Hollond, and Monck Mason, preliminary to the voyage to Weilburg, by reason of which the Vauxhall balloon is among the most famous of British balloons.[1]

Fourth and Fifth Ascents, Oct. 6 and 17, 1836.

The Weilburg Voyage, Nov. 7–8, 1836.

Undertaken at the suggestion and expense of Robert Hollond,[2] who (according to Monck Mason) had long cultivated a practical acquaintance with the art of aerostation, the voyage was organized in the main to give a full trial to Green's invention of the use of a more elaborate form of 'guide-rope' than he had hitherto used. The balloon having been lent for the occasion by the proprietors, Gye and Hughes, and the desire to make money out of the expedition being laudably absent, it was not advertised. Provided with numerous scientific instruments and taking a lavish amount of provisions and wine, together with parachutes for dropping communications and fireworks for use in case of a landing in the dark, the ascent was effected from Vauxhall Gardens about 1 o'clock on

[1] Monck Mason contributed to the newspapers accounts of his experiences on Sept. 27 and Oct. 17. Though written with some descriptive skill, they show early signs of the verbose and pontifical manner which marked his later and more elaborate contributions to aeronautical literature.

[2] Robert Hollond (1808–77), by profession a lawyer, and M.P. for Hastings between 1837 and 1852, made his first balloon trip with Green's son, from Oxford on May 15, 1830.

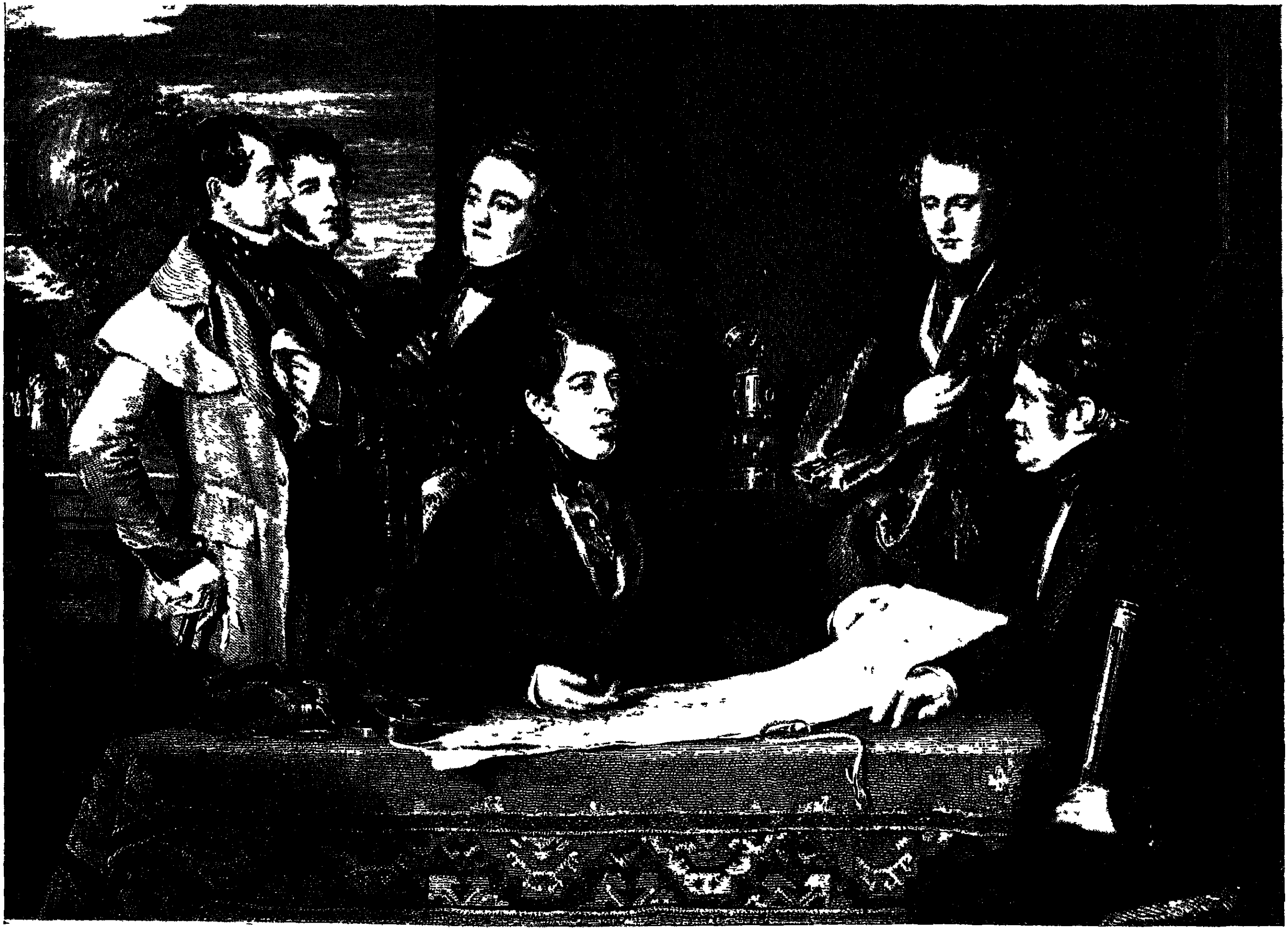


FIG. 91. CONSULTATION PRIOR TO THE AERIAL VOYAGE TO WEILBURG, NOV. 7, 1836.

W PRIDEAUX, ESQ — W M JAMES, ESQ — T MONCK MASON, ESQ

J HOLLINS, A R A — ROBERT HOLLOND, ESQ , M P — CHARLES GREEN, AERONAUT

November 7, 1836. The balloon was inflated to something like its full capacity, and Green is reported to have said that with a ton of ballast it would be possible to remain in the car for as long as three weeks. Rising gently in a moderate breeze from the south-west, the balloon was carried over Eltham and Bromley in the direction of Rochester and Canterbury, near which city (at a lower altitude) another current set the balloon to northward. Green therefore threw out ballast, and on rising again the former course of south-by-east was resumed. Soon after half-past four the English coast-line was crossed near Dover Castle. In anticipation of a fall in altitude during the night, the improved 'guide-rope', fitted with copper vessels specially designed to act as floating ballast on the sea, was lowered into the water, though scarcely had this operation been completed when the sound of waves announced to the aeronauts that they had crossed the Channel—a fact which (night having fallen) was confirmed by the lights of Calais glittering far below.[1] The crossing was thus accomplished—for the first time by Englishmen—at night, though without the danger and excitement of Blanchard and Jeffries's famous exploit in January 1785, and in the short space of about an hour. Monck Mason's description of this period of the voyage may be quoted as typical at once of his style of narration, and of the importance which was currently assigned to this remarkable achievement in the air.

'It would be very difficult, if not impossible, to convey to the minds of the uninitiated any adequate idea of the stupendous effect which such an exhibition, under all its concomitant peculiarities, was calculated to create. That we were, by such a mode of conveyance, amid the vast solitude of the skies, in the dead of night, unknown and unnoticed, secretly and silently reviewing kingdoms, exploring territories, and surveying cities, in such rapid succession as scarcely to afford time for criticism or conjecture, was in itself a consideration sufficient to give sublimity to far less interesting scenes than those which formed the subject of our present contemplations. If to this be added the uncertainty that from henceforward began to pervade the whole of our course—an uncertainty that every moment increased as we proceeded deeper into the shades of night, and became further removed from those landmarks to which we might have referred in aid of our conjectures, clothing every thing with the dark mantle of mystery, and leaving us in

[1] It is commonly said (e. g. *Ency Brit.*, 11th edition, 1910, vol. i, p 265) that Green was the inventor of the 'guide-rope', or 'trail-rope' as now termed, but Baldwin described two forms of it in *Airopaidia*, 1786, pp. 225 and 227, from whence Green very probably took the idea. The object of the trail-rope (usually about 300 feet long) is to economize ballast and facilitate landing.

doubt, more perplexing even than ignorance, as to where we were, whither we were proceeding, and what were the objects that so much attracted our attention—some faint idea may be formed of the peculiarity of our situation and of the impressions to which it naturally gave rise.

'In this manner, and under the influence of these sentiments did we traverse with rapid strides a large and interesting portion of the European continent, embracing within our horizon an immense succession of towns and villages, whereof those which occurred during the earlier part of the night, the presence of their artificial illumination alone enabled us to distinguish.'

Having passed over Liège, the environs of which city were ablaze with the fires from countless furnaces of its iron-works, the narrative continues :

'From this period of our voyage until the dawning of the following day, the record of our adventures becomes tinged with the obscurity of night. The face of nature completely excluded from our view, except when circumstances occasionally brought us into nearer contact with the earth, all our observations during the above period are necessarily confined to a register of incidents and sensations mingled with vague conjectures, and clouded with the mystery wherewith darkness and uncertainty were destined to involve so large a portion of the remainder of our expedition. The moon, to which we might have looked up for companionship and assistance, had she been present, was no where to be seen. The sky, at all times darker when viewed from an elevation than it appears to those inhabiting the lower regions of the earth, seemed almost black with the intensity of night; while by contrast no doubt, and the remotion of intervening vapours, the stars, redoubled in their lustre, shone like sparks of the whitest silver scattered upon the jetty dome around us. Occasionally faint flashes of lightning, proceeding chiefly from the northern hemisphere, would for an instant illuminate the horizon, and after disclosing a transient prospect of the adjacent country, suddenly subside, leaving us involved in more than our original obscurity.

'Nothing in fact could exceed the density of night which prevailed during this particular period of the voyage. Not a single object of terrestial nature could anywhere be distinguished; an unfathomable abyss of "darkness visible" seemed to compass us on every side, and as we looked forward into its black obscurity in the direction in which we were proceeding, we could scarcely avoid the impression that we were cleaving our way through an interminable mass of black marble in which we were imbedded, and which, solid a few inches before us, seemed to soften as we approached, in order to admit us still farther within the precincts of its cold and dusky enclosure.' [1]

[1] Mason (Monck) *Account of the late Aeronautical Expedition*, &c., 1836, p. 27. With reference to the last paragraph above quoted it is of interest to note that the same simile is used by Joseph Conrad in describing his first aerial flight, '. . . I had sometimes the illusion of sitting as if by enchantment in a block of suspended marble' (*Notes on Life and Letters*, 1921, p. 285).

RULE, BRITANNIA,

ON THE SEA AND IN THE AIR.

Expertus vacuum Dædalus aëra
Pennis non homini datis
Nil mortalibus arduum est.
Cœlum ipsum petimus.
HORAT

CAROLO GREENIO,

BRITANNO,

ARTIFICI PERITISSIMO ET CLARISSIMO

Olim *Blanchardus* nostras delapsus ad oras
Insolita clarum nomen ab arte tulit.
Sed breve per spatium Mœno Taunoque relicto
Finis erat celeris Vilinaburga viæ.
Nunc, post lustra decem, majus quid *Greenius* ausus
A Tamesi ad Lanam deproperavit iter.
Per mare, per fluvios, montes transgressus et urbes,
Nec noctis tenebras horruit impavidus.
Cedite, Romani, Graji quoque, cedite, Galli;
Dædaleam laurum *Greenius* unus habet.

Scr. Weilburgi in Nassovia d. 19. Nov. A. MDCCCXXXVI.

FIG 92 LATIN VERSES PRINTED AT WEILBURG IN HONOUR OF CHARLES GREEN COMMEMORATIVE OF A VOYAGE FROM VAUXHALL, NOV 7-8, 1836.

Landing near Weilburg, Nov. 8, 1836.

Carried from Calais over the towns of Ypres, Lille, Brussels, Namur, Liège, and Spa, the balloon—shortly after 6 o'clock in the morning—crossed the Rhine to the north of Coblentz, and after the sun had thrice been made to rise by variations in the balloon's altitude, preparations were made to descend. Despite some minor difficulties which at one moment threatened a crash among the tree-tops of the wooded country in which the aeronauts found themselves, Green's skilful handling of the balloon resulted in a safe landing in a field in the valley of Elbern, about eight miles from the town of Weilburg in Nassau—a place already noted in the annals of ballooning by reason of Blanchard's descent there in 1785. The actual landing was made at 7.30 a.m., the voyage of about 480 miles having thus occupied exactly eighteen hours.[1] Green and his companions were subsequently entertained in Weilburg with a lavish display of hospitality in honour of their adventure, the balloon—re-inflated as far as circumstances would allow—being ceremoniously christened 'The Great Balloon of Nassau'. As a token of his appreciation of the hospitality extended by the authorities of the city, Green presented to the Archduke of Nassau the two flags he had carried in 221 previous ascents, and they were deposited in the ducal palace side by side with the flag which Blanchard had in like manner presented more than fifty years earlier.

Meanwhile in England great interest and anxiety, mingled with varying conjectures and the usual crop of unauthorized rumours, were aroused as to the fate of the aeronauts.[2] It was not, however, until a week later that the first details of the voyage were published in the London daily papers, and posted in the clubs of the West End. The news of this record aerial flight of nearly 500 miles appealed to the public imagination—'Your voyage so occupied my mind', wrote J. M. W. Turner to Hollond, at a later date, 'that I dreamt of it'—and it was hailed as one of the greatest achievements in the annals of aerostation.[3]

[1] This record of a balloon flight from England was not beaten until October 1907, when A. E. Gaudron, J. L. Tannar, and C. C. Turner crossed from London to Sweden, 702 miles in nineteen hours.

[2] The Cuthbert Collection contains a broadside announcing that the rumour of the balloon having fallen in the North Sea was false, and that in fact the aeronauts had landed near Grenoble, after three nights in the air! *The Times* unwittingly printed a forged letter as to a descent near Rotterdam, corrected by an authorized statement in the issue of Nov. 15. Barham, in a poem on 'The "Monstre" Balloon' (*Ingoldsby Legends*, First Series) made fun of these rumours and of other incidents of the voyage.

[3] A silver medal was struck to commemorate the event (see Fig. 33, p. 136). The eulogistic Latin verses (Fig. 92) were printed by Monck Mason (p. 351) with a translation.

Monck Mason's *Account*, 1836.

Before the end of the year Monck Mason published his *Account*, which, though not without literary merit and marked with considerable powers of observation, contained little of scientific interest. His claim that the experiment with the 'guide-rope'—the chief object of the expedition—had proved wholly successful, was greatly overstated in the suggestion that 'with such an instrument . . . there now seems to be no limit to the powers of aerostation; no bounds to its sphere of action'. Moreover, his contention that the balloon landed with power enough to have made possible a voyage 'throughout the whole circumference of the globe', may perhaps be taken as a measure of his pretensions in the sphere of scientific ballooning. It is true that in the enlarged edition published under the title of *Aeronautica, or Sketches illustrative of the Theory and Practice of Aerostation*, Monck Mason exposed some of the common fallacies on the subject, and laid down the main principles governing the use of the balloon, while his reasoned contributions—printed as an appendix—on the important question of directing balloons, showed an advance in the direction of 'strict mathematical induction'. But in a general way his observations are lacking in originality and sound knowledge, while his profusion of words and a certain pretentiousness of style, convey an impression of superficiality which is, to say the least, tedious.[1]

Ascents from Paris, Dec. 19, 1836, and Jan. 9, 1837.

Before bringing the Nassau balloon back to England it was conveyed to Paris, where Green made two ascents from the barracks in the Faubourg Poissonnière, Gay-Lussac, the distinguished French scientist (who achieved some notable ascents to high altitudes in 1849), being one of the passengers on the first occasion. Early in the spring of 1837 ascents were renewed from Vauxhall Gardens and elsewhere, the fame of the Nassau voyage attracting greater crowds than ever.[2] But while Green's piloting of the balloon was uniformly successful, the summer did not pass without a tragedy which, involving the life of the amateur parachutist, Robert Cocking, nearly terminated the career of Green and his companion, Edward Spencer. The story so far as it concerns Cocking

[1] The original log of the voyage kept by Hollond, with various letters relating thereto, was offered for sale at £27 10*s*. in a catalogue (no. 326, 1919, item no. 4) issued by T. Thorp, bookseller, Guildford. Presumably this came from the sale of Mrs. John Hollond's property, including aeronautical books, engravings and drawings, at Wonham House, Bampton, Devon, in December 1916.

[2] An interesting spectator present at the ascent on May 15, 1836, was Sir George Cayley.

is recorded elsewhere, and it is only necessary to relate here the hazardous part which Green was called upon to play.

Ascent with Cocking's Parachute, July 24, 1837.

It is clear that Green was averse from the experiment and fully realized the danger of piloting the balloon with so heavy a detachable load. But in view of Cocking's persistence and Green's obligation to act under the instructions of the proprietors of Vauxhall Gardens—by whose consent the affair was eventually arranged to take place on July 24—Green, with characteristic pluck, waived his own objections. Nevertheless, he declined to be in any way responsible for the release of the parachute, which—by means of a rope and trigger—was left in Cocking's hands to operate, while Green concerned himself with the necessary precautions to guard against the inevitable danger involved in the rapid ascent of the balloon which was bound to follow directly the great weight of the parachute was released. The need for these precautionary measures is clearly realized from the vivid description which Green issued to the press after the accident. Having with difficulty attained an altitude of about 5,000 feet, Green and his companion were informed by Cocking of his intention to free the parachute.

'At this instant', the narrative runs, 'I desired Mr. Spencer to take fast hold of the ropes, and, like myself, to crouch down in the car. In consequence of being compelled to keep hold of the valve line, of course I had but one hand which was available for the purposes of safety. With that hand, fortunately, in the perilous situation into which we were speedily thrown, I was able to maintain my position. Scarcely were these words uttered before we felt a slight jerk upon the liberating iron, but quickly discovered, from not having changed our elevation, that Mr. Cocking had failed in his attempt to free himself. Another but more powerful jerk ensued, and in an instant the balloon shot upwards with the velocity of a skyrocket. The effect upon us at this moment is almost beyond description. The immense machine which suspended us between "heaven and earth", whilst it appeared to be forced upwards with terrific violence and rapidity through unknown and untravelled regions, amidst the howlings of a fearful hurricane, rolled about as though revelling in a freedom for which it had long struggled, but of which until that moment it had been kept in utter ignorance. It at length, as if somewhat fatigued by its exertions, gradually assumed the motions of a snake working its way with astonishing speed towards a given object. During this frightful operation, the gas was rushing in torrents from the upper and lower valves, but more particularly from the latter, as the density of the atmosphere through which we were forcing our progress pressed so heavily on the valve at the top of the balloon as to admit of comparatively but a small escape by the aperture. At this

juncture, had it not been for the application to our mouths of two pipes leading into an air bag with which we had furnished ourselves previous to starting, we must within a minute have been suffocated, and so, but by different means, have shared the melancholy fate of our friend. The bag was formed of silk, sufficiently capacious to contain 100 gallons of atmospheric air. Prior to our ascent the bag was inflated, with the assistance of a pair of bellows, with 50 gallons of air, so allowing for any expansion which might be produced in the upper regions. Into one end of this bag were introduced two flexible tubes, and the moment we felt ourselves to be going up, in the manner just described, Mr. Spencer, as well as myself, placed either of them in our mouths. By this simple contrivance we preserved ourselves from instantaneous suffocation, a result which must have ensued from the apparently endless volume of gas with which the car was enveloped. The gas, notwithstanding all our precautions, from the violence of its operation on the human frame, almost immediately deprived us of sight, and we were both, as far as our visionary powers were concerned, in a state of total darkness for four or five minutes.

'As soon as we had partially regained the use of our eyes, and had somewhat recovered from the effects of the awful scene into which, from the circumstances, we had been plunged, our first attention was directed to the barometer. I soon discovered that my powers had not sufficiently returned to enable me to see the mercury, but Mr. Spencer found that it stood at 13 20, giving an elevation of 23,384 feet, or about four miles and a quarter. I do not conceive, from the length of time I had been liberating the gas, that this was anything like our greatest altitude, for we were evidently effecting a rapid descent. This impression is corroborated by a rough calculation, which leads me to believe, knowing the customary rate at which the gas makes its escape, taken [into] consideration in conjunction with the length of time I had been pulling the valve-line, that we had lost at least 30,000 feet of gas, or 180,000 gallons, a total of 5,000 feet more than my own balloon will contain. It may be regarded as somewhat surprising that not a larger quantity had evaporated, especially when the size of the valves are considered, that at the top being nearly three feet in diameter, whilst the one at the neck of the balloon is upwards of two feet. The reason, however, is easily explained. The extreme rapidity with which we ascended, coupled with the consequent pressure of the atmosphere on the upper part of the machine, necessarily prevented much escape from the top valve. The same cause also forced an extraordinary emission from the opening of the neck, and I am decidedly of opinion, had it not fortuitously happened that the proprietors permitted this latter valve to be increased from 18 to 25 inches in diameter, that the balloon must have burst and my companion as well as myself been hurled headlong into eternity.' [1]

[1] *The Times*, July 26, 1837; *The Mirror*, no. 846, July 29, 1837, &c. Green gave evidence at length at the inquest held as to the cause of Cocking's death. The admirable way in which he did so called forth eulogistic comments from the coroner.

Fig. 93 CHARLES GREEN.

Fig 94 EDWARD SPENCER

aving survived the danger described, Green was able subsequently effect an easy landing close to the village of Offham, near Malling Kent, a distance of twenty-eight miles from London, which had een covered in about an hour and twenty minutes.

The terrible experience of the Cocking affair in no way affected reen's ballooning career, and his courage, as also his humanity, was iown in the fact that within a fortnight he made an ascent in aid the fund raised on behalf of the unfortunate parachutist's widow. Ascent for the Benefit of Cocking's Widow, Aug. 9, 1837.

Before the close of the season of 1837 he had two strange xperiences, the first occurring on August 14th, when on landing Osterley Park (after a flight from Vauxhall) the balloon and ar became fast in the top of a high tree—a position from which reen and his companion had some difficulty in extricating themelves; the second at Salford in October, on which occasion one f Green's assistants was lifted off his feet at the moment of ascent nd to the consternation and dread of the onlookers was carried p dangling in mid-air. Fortunately the man's training as a sailor nabled him to climb the rope, and he was pulled up safely into he car.

In the summer of 1838—during which he completed his 250th scent—Green made several voyages from Vauxhall with George Rush, of Elsenham Hall in Essex, a gentleman of means, who wished o make meteorological and other scientific observations at as great height as possible. On September 4th Green, Rush, and Spencer scended together, and during the flight the barometer fell from 0 inches to 14·70, thus indicating an altitude of 19,185 feet. bout a week later—with a small car carrying Green and Rush lone—the barometer fell to 14·30 inches, indicating a height of 0,352 (or more than three and three-quarter miles), a landing eing safely effected near Lewes.[1] His 250th Ascent, June 25, 1838. Experimental Ascents with Rush, Sept. 4 and 10, 1838.

On September 14th John Poole—best known as the author of *Paul Pry*—accompanied Green in an ascent from Vauxhall Gardens, n entertaining though '[un]scientific account' of which experience Poole subsequently published under the title of *Crotchets in the Air*. At the end of the month it was announced that Green would ascend accompanied by Van Amburgh (a trainer of wild animals) Poole's *Crotchets in the Air*, 1838.

[1] Some years later Rush published *An Account of [Sixteen] Ascents in the Nassau and Victoria Balloons in 1838, '49 and '50, with a Description of Rush's Registered Dials for the improved Aneroid Barometer*, 1851. Rush quotes a long account by Gay-Lussac of the scientific ascent on Sept. 17, 1804, during which his highest altitude, 22,873 feet, was attained. In Chas. Green's opinion (letter dated 1837) this figure was much exaggerated.

and his tiger, and though it is difficult to believe he can have approved of such ridiculous exhibitions it is not to be regretted that the magistrates prohibited the venture.[1]

Projected Atlantic Crossing, 1840.

During 1840 Green made but a few ascents, possibly owing to the fact that at this time Frederick Gye gave up Vauxhall Gardens, a change of proprietorship which resulted in the Nassau balloon being put up for public sale at the Auction Mart, where Green himself was the purchaser at £500. But his cessation from ballooning may also have been due to his preoccupation with the project of a balloon crossing of the Atlantic. There can be no doubt Green regarded this daring conception as a practical scheme under certain conditions—in a letter written in August he definitely stated his intention of 'making an aerial voyage from the new world to the old'. His confidence was mainly based on repeated observations as to the westerly currents blowing over from the Atlantic, which in common with other aeronauts he had uniformly experienced at high altitudes.[2] In the previous spring he prepared a model of his so-called 'Atlantic Balloon', with which experiments were made in a method of effecting a 'partial direction of the balloon' (Fig. 95). This was successfully carried out by means of small 'fans' or 'propellers' (actuated by clockwork mechanism), which could be so adjusted as to impel the balloon upwards, downwards, or in a horizontal direction. In the latter case a 'guide-rope' was affixed to demonstrate (under conditions which cannot be said to justifiy the contemporary comment that these 'experiments were grafted on sound scientific knowledge') the effect of the rope in maintaining the small model balloon at a uniform height.[3] The full-scale design embodied the use of a rudder, and the machinery (no mention is made of the

[1] Poole—who witnessed the awful fate of Mme. Blanchard in Paris in July 1819, through the burning of her balloon during an ascent with fireworks—did not hesitate to condemn as both 'brutal and stupid' such exhibitions as balloon fireworks or 'tiger-ascents'. Incidentally it is curious to note that Hatton Turnor, in reprinting *Crotchets in the Air*, regrets his inability to trace the author! (see *Astra Castra*, pp. 399 et seq.).

[2] An announcement as to an Atlantic voyage made by Green in Paris in 1836 is said to have elicited from Sir Sidney Smith confirmation as to westerly currents, and an offer to accompany Green from New York to England.

[3] These experiments were so conducted by Green as to illustrate lectures on 'the principles and application of aerostation' given by John Cooper. For a full description of the balloon and mechanism see *The Mirror*, no. 999, Apr. 4, 1840, where it is said that the 'propellers' were originally designed by J. J. C. Taylor, an engineer, for the propulsion of ships. In 1867 Green exhibited his model at a meeting of the Aeronaut. Soc. when it was explained by F. H. Wenham (Report for 1867, p. 29).

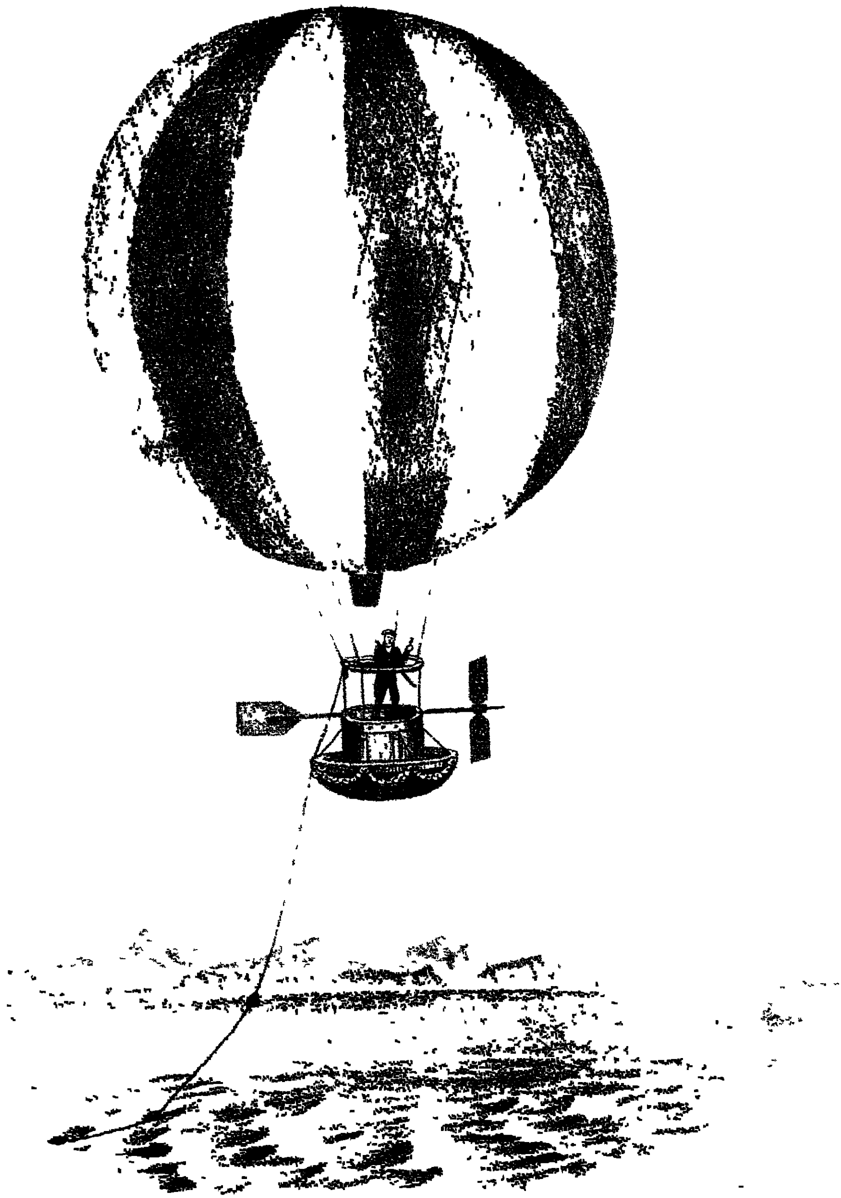


Fig. 95. GREEN'S PROPOSED ATLANTIC BALLOON, 1840.

motive power) was to be fitted on a platform between the car and the balloon.

As to the 'guide-rope', this consisted of a 2,000 foot rope, to the lower extremity of which were attached at intervals small canvas bags with a valve-line aperture (allowing of the inflow of water when immersed), between which were attached a number of conical floats of hollow copper. The action of the rope was intended to relieve the balloon of weight on descending, and to restrain the subsequent rise by means of the water-filled bags—a device which Green professed to believe would make possible a continuous flight, if necessary, of three months.[1]

His Ascents during 1841–52.

For the next three or four years he continued comparatively inactive, but during 1845 he made a number of ascents from the Gardens of Cremorne House, his 302nd taking place on July 7th of that year. On several occasions he went up at night with the balloon illuminated—to use the attractive wording of the advertisements 'he ascended in a cloud of exasperated pyrotecnics'—while in September he went up with a lady and a small leopard in the car. At this period he generally made use of the Nassau balloon, but apparently the old Coronation balloon was still in use.[2] In 1842 he also acquired from Hampton the latter aeronaut's Albion balloon, but this was badly damaged (one of the few accidents which occurred to Green in later years) in an ascent from Cremorne in August 1845.

During the last six years of his ballooning career—that is from 1846 to 1852—Green, possibly incited by the desire to complete 500 voyages, renewed his exertions and made many ascents. These were mostly undertaken from Vauxhall Gardens, which had regained at this time some measure of its former prosperity, varied by others from towns in the southern counties. In May 1852 the veteran announced in a manner common to popular entertainers, his 'First Farewell Ascent', though his retirement was deferred until later in the year. In his last notable achievements (made in the following autumn) he co-operated with John Welsh (1824–59),

[1] The design and use of the 'guide-rope', as intended for the Atlantic crossing, were described by Green in the *Polytechnic Journal* for January 1840, p. 75. See *ante*, p. 251.

[2] The Nassau balloon was in use for more than thirty-five years—a remarkable record. In 1851 Hampton (in a letter to the press on ballooning) warned Green that his balloon must be for that reason, 'as rotten as can possibly be', though Green continued to use it without accident. Subsequently this 'historical heirloom' passed into Coxwell's possession, and (having renovated the silk) he made an ascent with it in Sept. 1873 (see p. 272). The small woodcut of the Coronation balloon used for hand-bills in 1825, was used on a poster of Green's 411th ascent from Leicester on June 27, 1849.

Scientific Ascents with Welsh, Aug. 1852. His 500th Ascent, Sept. 13, 1852.

of the Kew Observatory, in a series of four scientific ascents made under the auspices of the British Association, when the 'Nassau' balloon attained heights varying between 12,640 and 22,930 feet.[1] Green's 'final' ascent—which it was announced would complete his '500th Aerial Voyage'—was fixed for September 8th, but was postponed to the 13th.[2] Doubtless the auspicious event accounted for the large number of passengers, eight of whom, including Henry Mayhew (1812–87), the well-known author of many humorous stories and plays, availed themselves of a last journey with the 'old ethereal pilot'. As a matter of fact the landing, made after dusk on Pirbright Common, near Guildford, was fraught with some danger, though—as may be fittingly recorded of one of the last flights in Green's notable career—what might have been a serious accident was avoided by the exercise of his commanding personality not less than his skill as a pilot, and nothing worse happened than a severe shaking for his alarmed passengers.[3]

His Death, Mar. 26, 1870.

Thereafter Green retired from the public gaze, though his attendance at the early meetings of the Aeronautical Society testifies to his surviving interest in the widening field of aeronautics.[4] During the latter years of his life he resided in a small house—appropriately named 'Aerial Cottage'—at Highgate. His death from heart failure occurred at Tufnell Park on March 26, 1870, at the advanced age of eighty-five.

His Character and Attainments.

Charles Green, like his predecessor James Sadler, was a sturdy type of Englishman. Though lacking in education and without scientific training (to which, however, he made no undue preten-

[1] The scientific results were published in the *Phil. Trans.*, 1853, pp. 311–46. See also Glaisher (p. 28), who relates the remarkable circumstance that on the occasion of the fourth ascent he watched the balloon through a good telescope from Greenwich Observatory, and was able to observe its entire course from the ascent at Vauxhall (2 hrs. 22 min.) to its descent near Folkestone (3 hrs. 40 min.).

[2] Cf. Glaisher's statement in the *Aeronaut. Soc., First Report*, 1866 (p. 45), as to Green being 'the hero of 500 ascents', with that in *Travels in the Air*, 1871 (p. 30), 'nearly 1,400 ascents'. In the *Fourth Report*, 1869 (p. 90), the number is given as 'upwards of 700', and in the *D. N. B.* as 526, while Tissandier reports Green as having said he made 'more than 6,000 aerial excursions' (*Travels in the Air*, p. 330). The Cuthbert Collection includes over 160 posters or hand-bills of Green's ascents, dating from July 18, 1821 to Sept. 13, 1852. Green himself, in a letter of Nov. 2, 1852 (see Maggs' Catalogue, Part 2, 1923, p. 151) stated he had 'made 504 ascents', and had no intention of making others 'except for scientific purposes'. But see also under Green (C.) in *Modern English Biography*, vol. i, 1892, where the number is given as 527.

[3] Mayhew contributed an account of his adventure 'In the Clouds' to the *Illus. London News*, Sept. 18, 1852. Reprinted in *Astra Castra*, p. 220.

[4] *Aeronaut. Soc., Second Report*, 1867, p. 29. The incident there related by Wenham affords an interesting link between aerostation and aviation.

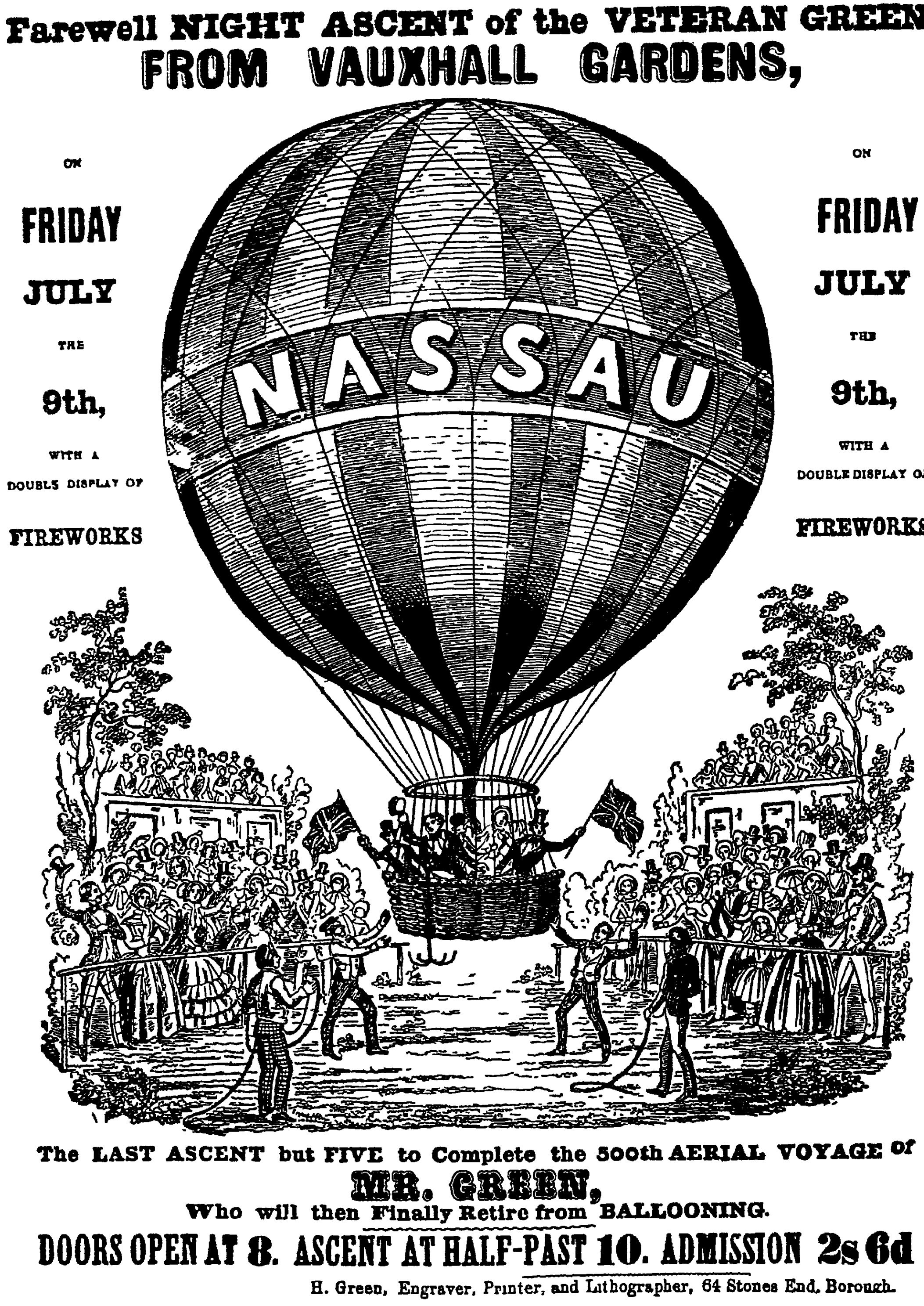


FIG 96 HANDBILL OF GREEN'S 495th ASCENT, JULY 9, 1852

sions), he acquired a large fund of experience in handling balloons, which in combination with pluck, admirable self-possession, and a sound judgment, made him an excellent pilot. His self-possession was seldom better exemplified than when, after an ascent from North Shields in November 1834—made without either car or ballast, owing to lack of gas—he dropped with great force into the Tyne, and stuck in the mud in 9½ feet of water. Realizing that the balloon, relieved of weight, would tend to lift, he hung on to the cords and was drawn to the surface, being finally rescued and landed at Howden-on-Tyne. In all that pertained to the technique of ballooning he paid careful and methodical attention—he is said, for instance, to have studied the composition of the most effective kind of 'varnish' for use on the envelope. His name became widely known and as widely respected, and many of those who enjoyed balloon voyages in his company bore testimony to his excellent qualities. In the air he was taciturn and even peremptory—his passengers received precise instructions as to the throwing out of ballast in case of need—but returned to earth he delighted all (as Henry Mayhew wrote) 'by his intelligence, his enterprise, his enthusiasm, and his courtesy'.

The introduction of the use of coal-gas was clearly his most practical contribution to the improvement of the balloon, a machine which it is true he used in the main only for exhibition or spectacular purposes. As previously mentioned, his demonstrations of the utility of the trail-rope were not wholly original, and his attempt to elaborate it for use in voyages oversea was not successful. In general, though modest as to his own achievements and in his attitude towards the whole science of aerostation, he regarded with serious enthusiasm that profession to which he devoted his life, and which—in the fitting words of Monck Mason—'he so long and so ably supported'.

The Family Record.

Green's enthusiasm and success as a professional balloonist spread in a minor degree to other members of his family. As related in the foregoing pages, his three brothers William, Henry, and James—more particularly the former—all played the part of aeronaut, while his father accompanied him when at an advanced age.[1] His first wife also occasionally accompanied Green in his

[1] An undated hand-bill in the Cuthbert Collection announces an 'Extraordinary Ascent of Mr. Green and his Three Sons from Vauxhall Gardens'.

ascents, and on occasions herself acted as pilot, though sometimes with the proviso that she would have charge only if the weather was 'not windy'. Green's only son, Charles George, also became a professional pilot, and up to 1853 had made at least 100 ascents, including several in his 'Continental Balloon' during visits to Berlin, Hanover—near which city he was nearly shot by ignorant peasantry—Brussels, and elsewhere on the Continent.[1] He never attained, however, the reputation enjoyed by his father, and his death in February 1864 closed the active record of the family of Green as professional balloonists.

[1] Charles George Green sometimes styled himself Charles Green, junr., or C. G. Green, doubtless in order to benefit by his father's renown. It may be added that the foregoing chapter is based mainly on news-cuttings and other material in the Cuthbert Aeronautical Collections, vol. 3 (Charles Green).

CHAPTER XII

THE DECLINE OF THE FREE BALLOON AND THE DEVELOPMENT OF AERONAUTICAL SCIENCE

SUCH harassing accidents and distressing fatalities as those recorded in Chapter X, viewed in conjunction with the growing tendency to attempt sensational feats, did much at this period to create what Coxwell called an 'anti-balloon mania'. The long and successful career of Charles Green—achieved, save for few exceptions, without the meretricious aid of thrilling 'stunts'—which commenced in 1821 and came to a close in September 1852, had engendered the opinion that ballooning, though not in itself useful, was at least an unobjectionable form of public amusement. For more than thirty years the renown of Green—the 'celebrated aeronaut', the 'Columbus of the Skies'—and the fame of the great 'Nassau' balloon, sufficed to attract large crowds. But as years passed the mere ascent of a balloon though still in some measure an attractive spectacle, became a commonplace and unexciting one, and it was said that the crowds drawn to watch the exploits of Mrs. Graham were in a large measure allured by her reputation for 'imminent deadly 'scapes'. Hence arose the tendency to ensure pecuniary success by the attraction of aerial feats of surpassing daring—equestrian ascents, balloon fireworks, gymnastics in mid-air, and so forth—which would appeal to the common desire for excitement, and the morbid taste of those ever ready to pay for the sight of life and limb risked 'to make a Roman holiday'.

Public Opinion and Ballooning, 1850–70.

The ill-repute which such exhibitions during the latter half of the nineteenth century called down on ballooning—exhibitions against which Hampton protested and Coxwell resolutely exerted his influence—was authoritatively expressed in 1866 by James Glaisher in his address to the newly-formed Council of the Aeronautical Society. He insisted that performances resorted to in order to pander to the public taste for the grotesque and the hazardous, had tended (in his own words) 'so far to degrade the subject that it has been, till very lately, looked upon with contempt by scientific classes in general'.[1] It is to the honour of Henry Coxwell that he strove not only to rescue ballooning from

[1] Aeronaut. Soc. of Great Britain: Aërial Locomotion [*First Annual Report*], 1866, p. 5; cf. also p. 9.

the hands of the showman and the mountebank, but to develop its use for military and scientific purposes, in which latter aim he was eagerly supported by Glaisher. That they did not achieve more and that their endeavours failed to result in further developments, was due mainly to the limitations of the 'free balloon' as an aeronautical machine—limitations inherent in its character as a non-navigable, single unit gas-bag. Nevertheless it must not be overlooked that its uses for meteorological and other purposes had not even then been scientifically tried out, while Coxwell's insistence on the balloon as a military machine was amply justified in the employment of observation balloons during the Great War. Moreover, in its more complex character as multiple units in a power-driven and navigable machine—in a word as an airship—the balloon has in recent years made possible aerial voyages of unsurpassed duration and extent. That, however, is another story—one far beyond the ken of Coxwell, whose aeronautical endeavours fifty years earlier were of a much more simple kind.

Henry Coxwell (1819–1900).

Henry (Tracey) Coxwell, youngest son of Commander J. Coxwell, R.N., was born on March 2, 1819, at Wouldham on the Medway. As a boy he was greatly excited at witnessing (through a telescope) the ascent of Green's balloon at Rochester in 1828, from which event his interest in aeronautics dated. Educated at Chatham he entered on life (after a brief and distasteful experience of the commercial world in Amsterdam) as apprentice to a surgeon-dentist. But even at this early period his thoughts were always turning to balloons, and in later years he looked back to the age of fifteen as a time at which he was already proficient in the principles of aerostation. On his family removing to Eltham, near London, he made a point of going to see as many balloon ascents as possible, one such memorable occasion being in July 1837, when from London Bridge he watched Cocking's parachute with forebodings as it passed overhead suspended beneath the giant 'Nassau' balloon. In August 1839 he witnessed Hampton's successful parachute descent at Bayswater, an event which led to an acquaintance with that aeronaut, his interest in ballooning—despite the fact that he was already in practice as a dentist—having by this time developed into something like a passion.

His First Ascent, Aug. 19, 1844.

In 1844 he afforded John Hampton—not for the first time—assistance in making a new balloon, in which, with his protégé, he made his first ascent (under the pseudonym of Wells) on

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FIG 97 FACSIMILE WRAPPER OF THE FIRST ENGLISH AERONAUTICAL MAGAZINE

August 19, 1844, from the White Conduit Gardens, Pentonville. The flight lasted only twenty-five minutes—' a tantalizing short-lived piece of grandeur '—but the delightful experience of the first imperceptible rising from the earth, the equally imperceptible and noiseless motion, and the grandeur of the panoramic view, created an impression which Coxwell recalled with delight over fifty years later.[1] In the year following his keen interest took the novel form of editing and publishing *The Balloon or Aerostatic Magazine*, which was the first English periodical devoted to any field of aeronautics (Fig. 97).[2] Meanwhile his aeronautical activities brought him into contact with Gypson and Gale, though Green (according to Coxwell, by reason of professional jealousy) appears to have avoided him. In 1847 he declined to ascend with Gale owing to objections he formed against the introduction of ' certain new fashioned valve springs ', and the danger inherent in Gale's device of supplementary balloons.[3]

His Narrow Escape with Gypson, July 6, 1847.

But during the course of the year 1847 he made several ascents with both Gale and Gypson, and it was with the latter, during a night ascent on July 6, that Coxwell went through one of the most alarming experiences in his career. Shortly after rising from the Vauxhall Gardens, and before the fireworks suspended from beneath the car had all gone off, the aeronauts found themselves in the midst of a severe thunderstorm.[4] Having risen to a height of about 7,000 feet Coxwell—who was sitting in the hoop—had just warned Gypson that the gas was blowing off through the neck, when suddenly there was a rushing noise, whereupon the balloon immediately began to collapse, and fell with appalling velocity—a situation which, made the more terrible in the midst of thunder and

[1] *Strand Mag.*, no. 142, July 1895, ' Mr. Henry Coxwell at Tottenham.' Coxwell avers that he first used a pseudonym for fear his patients would resent being attended by a ' balloonatic '.

[2] *The Balloon or Aerostatic Mag.*, edited by Henry Wells (pseud.), no. 1, August 1845. Projected as a monthly, it was discontinued after the publication of four numbers, though a Supplement of four leaves was added in July 1847. In 1859 Coxwell launched a similar venture, *The Aerostatic Mag.*, of which only one number appeared, but the title was again used for a pamphlet which Coxwell published in 1869, wherein (*inter alia*) he wrote with some bitterness against ' the so-called Aeronautical Society of Great Britain '. See Patent Office Library, Bibliographical Series, no. 14, 1905, p. 17.

[3] See Ch. X, p. 235.

[4] Coxwell, Second Series, pp. 57–61. It is remarkable that there are relatively very few recorded cases of a balloon being struck by lightning. A notable exception in quite recent times was afforded in the Gordon Bennett Balloon Race of 1923, when three balloons were struck by lightning and fell in flames.

Coxwell 'Parachutes' the Balloon.

lightning, may well have had a terrifying effect. All available ballast was at once thrown out, and Coxwell with admirable promptitude cut the neck-line, thus allowing the envelope of the balloon to assume in some measure the form of a parachute, with the result that the car providentially fell in the Belgrave Road, Pimlico, with no more force than was sufficient to give the four occupants a severe shaking. According to Coxwell, who wrote a graphic account of the affair as a supplement to his *Balloon Magazine*—an account more accurate, probably, than the vivid description contributed by Albert Smith to the *Illustrated London News*—the accident was due to a large rent in the envelope extending 'about 8 feet from the valve to the equator'. But it is not easy to accept his explanation that this was due to pressure of air rushing back into a vacuum formed near the balloon by a flash of lightning.[1]

Ascents in Germany, 1848–51.

It is evident that this hair-breadth escape, taken in conjunction with his undiminished enthusiasm, weighed with him when he agreed in the spring of 1848 to conduct (as a business undertaking) a series of ascents on the Continent in Gale's balloon, his decision being based to some extent on the fact that as a pilot he would be in a position to rely on his own skill and resource. After a few initial trips in England he crossed to Antwerp with his balloon—which he altered and renamed 'The Sylph'—and during the next three years remained abroad, making ascents from Brussels, Berlin, Elberfeld, Cologne, Leipzig, and elsewhere. It is, retrospectively, not a little remarkable that at Berlin and Elberfeld in 1848–9 Coxwell demonstrated (from the lower of the two cars, which he retained) the practicability of dropping explosive bombs and 'aerial torpedoes' as a military operation.[2]

His Views on Military Ballooning.

Returning to England in the autumn of 1851 he took up the rôle so long enacted by Charles Green, and for the next thirty-four years devoted himself wholly to the task of rendering the balloon of practical use for scientific and military purposes. The latter was a favourite subject which he urged unavailingly on the military authorities for many years. In support of his ideas he gave exhibitions of signalling—by a somewhat cumbrous method—

[1] Cf. *The Balloon or Aerostatic Mag.*, Supplement, July 1847, and Albert Smith's account in the *Illus. London News*, July 9, 1847 (Fig. 98). It is just to say that the imputation of the latter that Coxwell gave way to 'extreme terror', is not borne out by the aeronaut's own frank admission, and is indeed confuted by the fact that within a week he was 'up' again with Lieut. Gale.

[2] Coxwell, Second Series, p. 5.

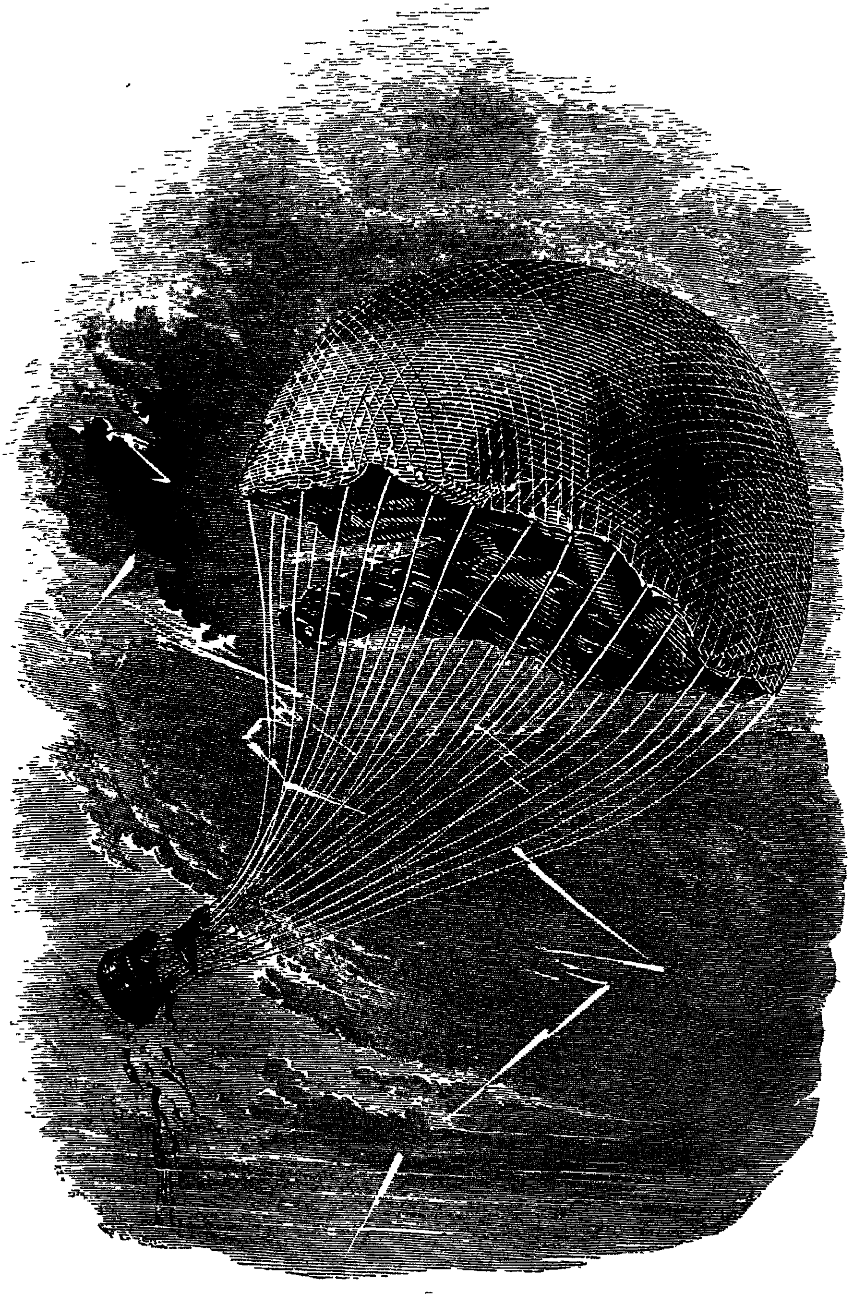


FIG 98 COXWELL'S ALARMING EXPERIENCE IN GYPSON'S BALLOON, JULY 6, 1847.

from a balloon in the Surrey Gardens, during the year 1854, and published his views in a pamphlet entitled, *Balloons for Warfare*, wherein the views of 'certain persons who are ever satisfied with ancient plans, and are decidedly hostile to anything new', were, at least on paper, satisfactorily demolished.[1] Nevertheless, it was not until July 1863 that Coxwell undertook an ascent from Aldershot with Lieut. G. E. Grover and Capt. F. Beaumont—two officers in the Royal Engineers, who during the previous year had read papers on the subject at Chatham—as official observers, under the direction of the Ordnance Select Committee. In his observations on the ascent Capt. Beaumont reported that the experiment confirmed the opinion expressed in his paper, that 'under certain circumstances, the balloon affords means to an army of carrying with it a lofty point of observation'—but there the matter rested for nearly ten years.[2]

First Official Experiment, 1863.

During the Franco-Prussian War of 1870 the German military authorities naturally turned to Coxwell, and at their request he went out to Cologne with two balloons to assist in the formation of the first German Balloon Corps, which, consisting of two detachments, was used in the operations against Strassburg, but shortly afterwards disbanded. In view of more recent events there is, again, some piquancy in Coxwell's comment that 'his instructions, however, were not lost, as may be gathered from the present efficiency of the Prussian Military Aeronauts'. It should be added, on the other hand, he showed his impartiality in 1871 by undertaking 'to get into Paris, letters, &c.', by means of balloons—a project which, as far as Coxwell was concerned, was rendered unavailing owing to the capitulation of the city.

Instructs a German Balloon Corps, 1870.

Reverting to earlier years it was in 1852 that Coxwell, having overcome family scruples, definitely entered upon a career as professional balloonist. His ascents now became very frequent, from Cremorne Gardens, the Crystal Palace, Sydenham (his connexion with which was inaugurated in 1859 by an ascent in the 'Queen'), as well as in the provinces. During one of these, made from North Woolwich on the night of June 15, 1857, he travelled (with two passengers) about 250 miles in five hours, a safe landing being

Adopts Ballooning as a Profession, 1852.

[1] *Balloons for Warfare. A Dialogue between an Aeronaut and a General*, 1854.

[2] See *Royal Engineers' Papers*, vol. xii, New Series; reprinted in *Astra Castra*, pp. 285–98. Grover and Beaumont subsequently acted on a Commission to report on Military Ballooning, 1871. See also Moedebeck, p. 225, &c., on Military Ballooning in England.

effected near Tavistock, just as the sun rose. An ascent made from Congleton in Cheshire on August 19, 1861, with two young men named Pearson, resulted in one of the worst 'bumps' in his career. On attempting to make a landing near Buxton, in country similar to that which brought disaster to Goulston, the car dashed against three low stone walls in succession, and was only checked in its dangerous career after having broken down a fourth. The two Pearsons, who owed their lives to the pluck they showed in obeying Coxwell's instructions to keep well down in the car, were badly hurt, the aeronaut himself receiving injuries which necessitated the use of crutches for several months.[1]

Coxwell's Co-operation with Glaisher, 1862–5.

As a scientific balloonist Coxwell's reputation rests mainly on the ascents he made with James Glaisher for the purpose of meteorological and other scientific observations, between 1862 and 1865. These ascents also brought Glaisher's name prominently before the public, though his primary interests were astronomy and meteorology, not aeronautics. Born at Rotherhithe in 1809 he became interested in astronomical science at an early age, and after working both at Cambridge University Observatory and at the Royal Observatory, Greenwich, he was in 1838 put in charge of a new magnetic and meteorological department of which he remained chief until 1874, during which long period he organized the science of meteorology and justly earned the title of 'Nestor of Meteorologists'.[2] In 1861, a committee having been appointed by the British Association to renew the efforts unsuccessfully made by Welsh in the 'Nassau' balloon during 1852, Glaisher agreed to accompany Coxwell as scientific observer during ascents to be made in a large balloon specially constructed by Coxwell for the purpose. It was made of American cloth with a capacity of 93,000 feet, and on account of its size was named 'The Mammoth Balloon'.

High Ascents from Wolverhampton, 1862.

During 1862 three ascents were made from Wolverhampton on July 17th, August 18th, and September 5th, accounts of which were subsequently written by both Coxwell and Glaisher, while the meteorological observations made by the latter were printed in full in the Association's Reports for 1862. The most remarkable of these was that on September 5, 1862, not only because the height attained constituted a record, but because its character entitles it to rank as a 'classic' ascent in the annals of

[1] Coxwell, Second Series, p. 74.

[2] *D. N. B.*, Second Supplement, 1912, vol. ii, p. 117.

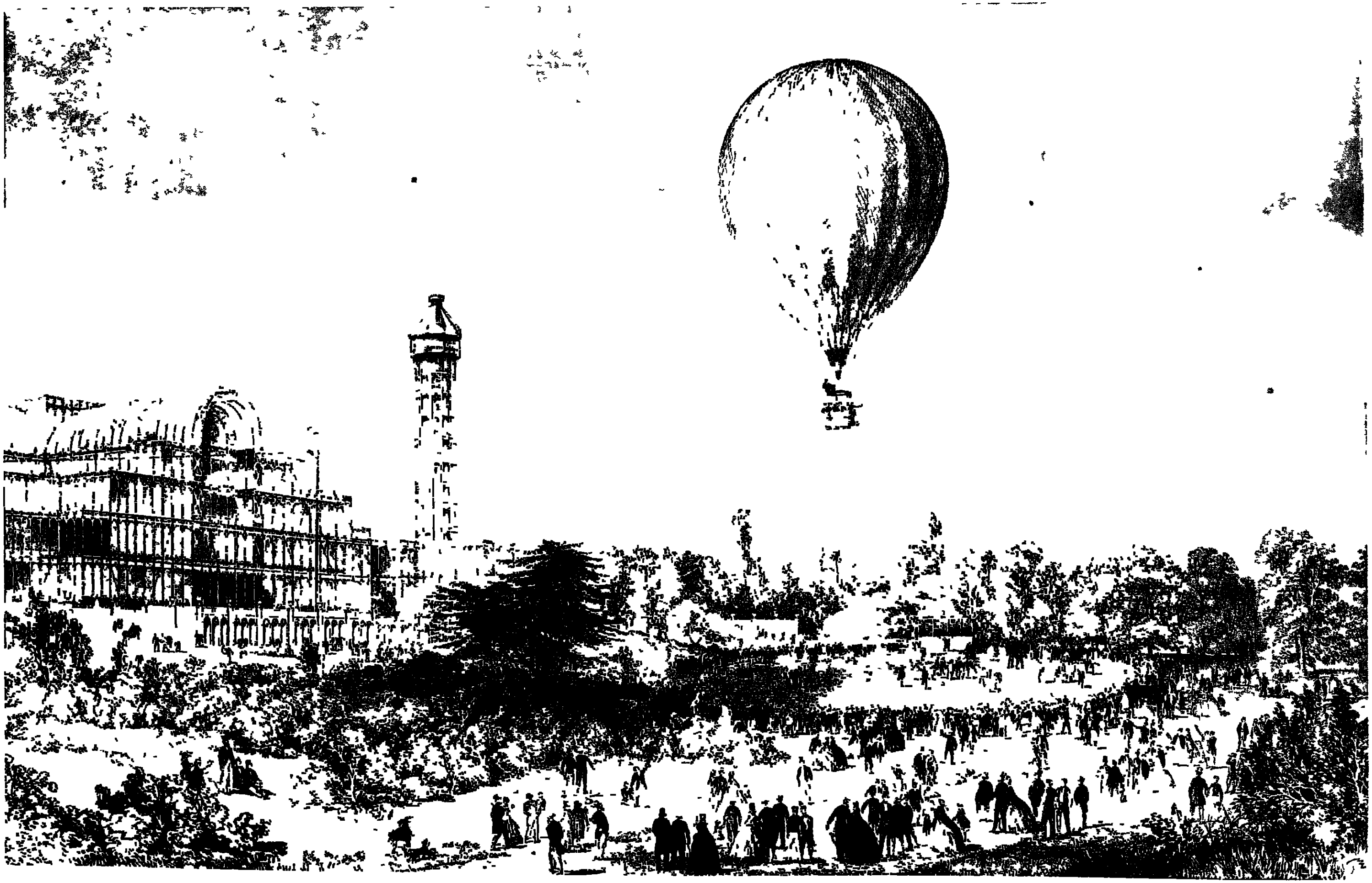


FIG. 99. COXWELL'S ASCENT IN THE 'MAMMOTH' BALLOON, WITH GLAISHER AND NINE PASSENGERS, CRYSTAL PALACE, SYDENHAM, SEPT. 1, 1862.

ballooning in England. The 'Mammoth' balloon, inflated with about 60,000 feet of gas, and in the car of which Glaisher had fitted eighteen or twenty scientific instruments, rose rapidly from the ground shortly after 1 o'clock. For the rest, though the story (as Coxwell said in later life) is an old one, it still bears repetition in Glaisher's own words:

The Record Highest, Sept. 5, 1862.

'We reached the elevation of four miles at 1 h. 40 m.; the temperature was 8°, the dew point minus 15°, or 47° below the freezing-point of water. Discharging sand, we attained in ten minutes the altitude of five miles, and the temperature had passed below zero, and then read minus 2°. . . . Up to this time I had taken observations with comfort, and experienced no difficulty in breathing, whilst Mr. Coxwell, in consequence of the exertions he had to make, had breathed with difficulty for some time. Having discharged sand, we ascended still higher; the aspirator became troublesome to work, and I also found a difficulty in seeing clearly. At 1 h. 51 m. the barometer read 10·8 in. About 1 h. 52 m. or later, I read the dry-bulb thermometer as minus 5°; after this I could not see the column of mercury in the wet-bulb thermometer, nor the hands of the watch, nor the fine divisions on any instrument. I asked Mr. Coxwell to help me to read the instruments. In consequence, however, of the rotatory motion of the balloon, which had continued without ceasing since leaving the earth, the valve-line had become entangled, and he had to leave the car and mount into the ring to readjust it. I then looked at the barometer and found its reading to be 9¾ in., still decreasing fast, implying a height exceeding 29,000 feet. Shortly after I laid my arm upon the table, possessed of its full vigour, but on being desirous of using it I found it powerless—it must have lost its power momentarily; trying to move the other arm, I found it powerless also. Then I tried to shake myself, and succeeded, but I seemed to have no limbs. In looking at the barometer my head fell over my left shoulder; I struggled and shook my body again, but could not move my arms. Getting my head upright for an instant only, it fell on my right shoulder, then I fell backwards, my back resting against the side of the car and my head on its edge. In this position my eyes were directed to Mr. Coxwell in the ring. When I shook my body I seemed to have full power over my muscles of the back, and considerably so over those of the neck, but none over either my arms or my legs. As in the case of the arms, so all muscular power was lost in an instant from my back and neck. I dimly saw Mr. Coxwell, and endeavoured to speak, but could not. In an instant intense darkness overcame me, so that the optic nerve suddenly lost power, but I was still conscious, with as active a brain as at the present moment whilst writing this. I thought I had been seized with asphyxia, and believed I should experience nothing more, as death would come unless we speedily descended. Other thoughts were entering my mind, when I suddenly became unconscious as on going to sleep. I cannot tell anything of the sense of hearing, as no sound reaches the ear

to break the perfect stillness and silence of the regions between six and seven miles above the earth. My last observation was made at 1 h. 54 m. above 29,000 feet. I suppose two or three minutes to have elapsed between my eyes becoming insensible to seeing fine divisions and 1 h. 54 m., and then two or three minutes more to have passed till I was insensible, which I think, therefore, took place about 1 h. 56 m. or 57 m.

'Whilst powerless, I heard the words "temperature" and "observation", and I knew Mr. Coxwell was in the car, speaking to and endeavouring to rouse me, therefore, consciousness and hearing had returned. . . . I heard him again say, "Do try, now do". Then the instruments became dimly visible, then Mr. Coxwell, and very shortly I saw clearly. Next I arose in my seat, and looked around as though waking from sleep, though not refreshed, and said to Mr. Coxwell, "I have been insensible", he said, "you have, and I too, very nearly". I then drew up my legs, which had been extended, and took a pencil in my hand to begin observations. Mr. Coxwell told me that he had lost the use of his hands, which were black, and I poured brandy over them.

'I resumed my observations at 2 h. 7 m., recording the barometer reading at 11·53 inches, and temperature minus 2°. . . . Mr. Coxwell told me that while in the ring, he felt it piercingly cold, that hoar-frost was all round the neck of the balloon, and that on attempting to leave the ring, he found his hands frozen. He had, therefore, to place his arms on the ring, and drop down. When he saw me he thought for a moment that I had lain back to rest myself, and he spoke to me without eliciting a reply; he then noticed that my legs projected and my arms hung down by my side, and saw that my countenance was serene and placid without the earnestness and anxiety he had observed before going into the ring; then it struck him that I was insensible. He wished to approach me, but could not; and when he felt insensibility coming over him too, he became anxious to open the valve. But in consequence of having lost the use of his hands he could not do this; ultimately he succeeded by seizing the cord with his teeth, and dipping his head two or three times, until the balloon took a decided turn downward.' [1]

Such is Glaisher's simple narrative of this remarkable adventure, written in the straight-forward, unsensational style typical of most personal records of great achievements in exploration and science. It is true that his computation as to having attained an altitude of 37,000 feet, or over seven miles high, has been questioned on the ground that becoming insensible at 29,000 feet, he could only conjecture the point at which the balloon began to descend. In any case the ascent was a record one in point of height—no man before, and very few since, have ever penetrated so far up into the unimaginable silences and immeasurably void

[1] Glaisher, p. 50, &c. (Fig. 100). Cf. Coxwell, Second Series, p. 137, &c.

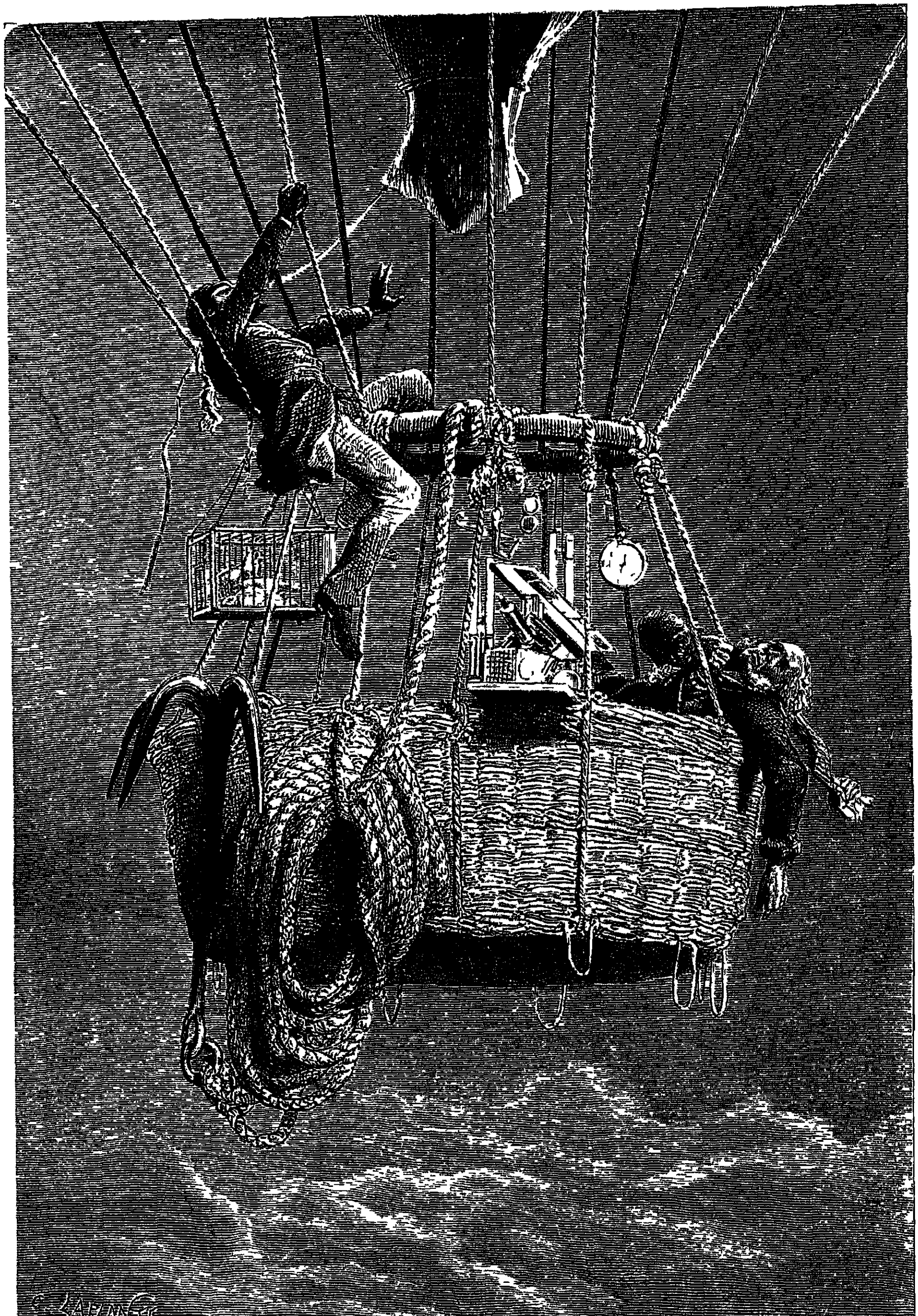


FIG 100 COXWELL AND GLAISHER'S FAMOUS HIGH ALTITUDE ASCENT (about 37,000 feet), WOLVERHAMPTON, SEPT. 5, 1862.

spaces of the earth's atmosphere.[1] But if Glaisher rightly refrained from claiming distinction on that score, and though the aerial regions offer to the explorer no such definite, albeit invisible objective, as a North or a South Pole, yet this ascent must always rank high in the annals of man's endeavours to explore the unknown and the inaccessible.

Other Ascents, 1863–6.

Of the other ascents—in eight of which altitudes between 10,000 and 26,000 were reached—made jointly by Coxwell and Glaisher, it is unnecessary to speak.[2] Glaisher continued during the next four years his meteorological observations from balloons—a method, it may be added, few scientific men have adopted—his last ascent being that from Windsor on May 26, 1866. In 1869 he contributed an account of his ascents to *Voyages Aériens*, in which C. Flammarion, W. de Fonvielle, and G. Tissandier were his coadjutors, a work of which he published an English edition in 1871, under the title of *Travels in the Air*. Meanwhile he had become interested in the foundation of the Aeronautical Society in 1866, and acted as its first treasurer. He retired from Greenwich Observatory in 1874, but retained his interests and mental vigour for many years. His death occurred at Croydon on February 7, 1903, in his ninety-fourth year.

His Death, Feb. 7, 1903.

Coxwell's Later Career.

Coxwell's career as a professional aeronaut lasted for several years after his association with Glaisher. On October 14, 1863, at Woolwich, he made his 500th ascent, and in the same year he made a 'first photographic trip' with Henry Negretti, from Lower Sydenham. In July of the year following he suffered at Leicester the experience—not unattended by personal danger at the hands of a mob—of having his balloon totally destroyed, a loss which (to the extent of £768) was deservedly made good. In 1865 he took up from Belfast ten passengers in his 'Research' balloon, and narrowly escaped fatalities on landing near the Carnlough Mountains. Owing to a mild panic on the part of some of the passengers who alighted too hurriedly, two of their number were carried off before the balloon could be secured. After a terrifying though brief experience they landed without injury some distance away, when the balloon again escaped and was only

[1] See *Brit. Association Report*, 1862, pp. 384–5. Probably Glaisher's record was passed on June 30, 1901, when the German balloon 'Preussen' ascended to 35,424 feet (10,800 metres), as officially recognized by the Fédération Aéronautique Internationale. See *Roy. Aero Club Year Book*.

[2] See Glaisher, chs. iv–vii, and *Ency. Brit.*, 11th edition (Aeronautics), p. 266.

recovered from the water in a wrecked condition. In September 1873, having acquired (presumably on the death of Charles Green) the famous 'Nassau' balloon, Coxwell 'thoroughly renovated' the silk and ascended in it to over 10,000 ft. from Hornsey.

His Last Ascent, June 17, 1885.

On June 17, 1885, Coxwell made the last balloon ascent of his career at York, during the gala week, a function at which for twenty-seven consecutive years (without one disappointment) he had given an exhibition of his skill.[1] After his retirement he found a congenial occupation in writing an account of his own career, published during 1887–9 in two series under the title of *My Life and Balloon Experiences.* Though interesting, and doubtless conveying an adequate impression of the character of the writer and of his experiences, they are garrulous and ill-arranged to a degree that must irritate any serious reader. He continued to maintain his interest in ballooning to the end of his life, one of his last letters to the press (written in December 1899) being on the subject of the use of 'Montgolfière' balloons in the Boer War. His death occurred at Seaford in Sussex on January 5, 1900.[2]

His Death, Jan. 5, 1900.

His Character and Skill as an Aeronaut.

Henry Coxwell's character though simple, in some respects even mediocre, was marked by stout independence, manliness, and honesty of purpose. His life-long interest in ballooning and his knowledge and experience of the practical and technical aspects of his professional work, coupled with the exercise of a 'phrenological bump of *caution*' (to use his own words), developed in him the qualities requisite in a successful pilot. But he acquired in later life an undue sense of his own importance in the sphere of aeronautical endeavour, which for him was wholly confined to the activities of a stalwart advocate of the uses, the limited military and meteorological uses, of the free balloon.[3] His embittered feelings of personal jealousy and animosity against the pretensions of the 'Aeronautical Society' were exhibited in a letter to *The*

[1] Coxwell's regard for the ancient city is shown in the fact that the latest balloons of his 'aerial fleet' were called the 'York Express' and 'The City of York'. In the *Aeronaut. Soc. Report* for 1880 (p. 19) reference is made to Coxwell's 1,000th ascent having been made at York in June of that year.

[2] *D. N. B.*, Supplement 1, vol. ii; Coxwell (H.), *My Life &c.*, Two Series, 1887–9; Glaisher (J.), *Travels in the Air*, 1871; Cuthbert Collection news-cuttings; *Aeronaut. Journal*, vol. iv, 1900, pp. 107 and (obituary) 118. A memorial tablet to Coxwell was erected in the parish church at Seaford.

[3] Coxwell's attitude is revealed in a warm dispute with Thomas Moy at a meeting of the Aeronautical Society (*Report* for 1880, p. 22). 'If Mr. Moy will leave ballooning to me', he said, after a sharp criticism of theoretical flight, uttered as from an actual 'aeronaut', 'I will leave flying to him.'

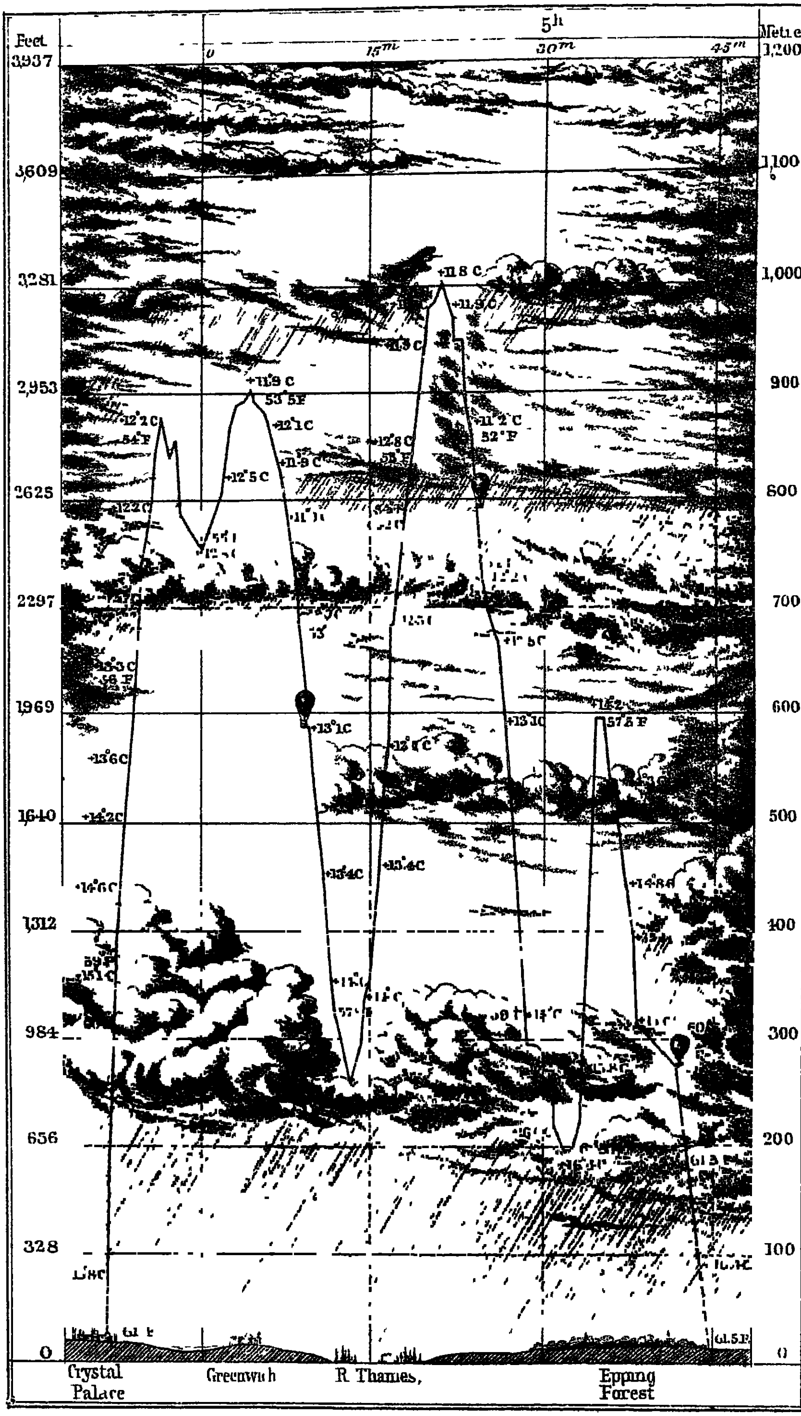


FIG. 101. PATH OF COXWELL'S BALLOON, CRYSTAL PALACE TO EPPING FOREST, JULY 21, 1863.

Times and in his own *Aerostatic Magazine* for 1869. The Exhibition of 1868 in particular aroused his ire—presumably he was not invited to take part in it—for while admitting that certain of the exhibitors 'displayed considerable ingenuity and inventive genius', he regarded the inability to achieve any success in the direction of mechanical flight as synonymous with ultimate failure. The plain fact is that as an experienced balloon pilot his skill was undeniable, but the calibre of his mind and his lack of scientific training did not fit him to grasp the widening fields of theoretical aeronautics, whether heavier- or lighter-than-air.

The close of Coxwell's career may be said to coincide with the final abandonment of any hope of developing the free balloon as an aeronautical machine. The contemporary aeronauts of the later years of his career, men like Thomas Lythgoe, J. A. Whelan, Thomas Wright, 'Captain' W. D. Dale, John Youens, and (a little later) Percival, Arthur, and Stanley Spencer, can hardly be regarded otherwise than as public entertainers using the balloon as the instrument of their performances—an instrument, it is true, the use of which occasionally involved the hazard of life.[1] Coxwell himself continued to insist that ballooning was still in its infancy and would lead to aerial navigation, but he significantly referred on the last page of his autobiography—with a characteristic lack of scientific exactitude—to other factors in aeronautics, namely the 'wonderful sustaining powers of air' and the need of a 'motive force'. His more scientific colleague Glaisher had come many years earlier (1870) to the conclusion that the balloon—which, in his own words, he was content to use as he found it—though admirable for vertical ascents was not capable of being steered. Indeed, he went so far as to assert that he did not regard it as 'necessarily a first step in Aerial Navigation', and he conceived that possibly it might 'have no share in the solution of the problem'.[2] It is clear that at

[1] T. Lythgoe (1832–93), an inspector of the Metropolitan Gas Co., made several hundred ascents, and was the first to go up (in 1859) from the Crystal Palace, Sydenham. Youens made frequent ascents from the Crystal Palace, and recorded his 200th ascent in July, 1878. Dale (1844–92) made about 200 ascents from the same place, and was killed in the vicinity owing to the bursting of his balloon. Wright took over some of Coxwell's more regular engagements on the latter's retirement. (See Boase (F.), *Modern Eng. Biography*, five vols. 1892–1912.) Another professional balloonist, 'Capt. W. H. Hall, who performed sensational feats from a trapeze suspended below the car, was killed in a fall from his balloon at Newcastle, Aug. 14, 1859.

[2] Glaisher, p. xiii. Cf. his Address in the *First Annual Report of the Aeronaut. Soc.*, 1866, p. 5. The ideas prevailing about this time were examined at length by Pettigrew (J. Bell) in a Dissertation on Aeronautics appended to his *Animal Locomotion*, 1873.

this period increasing dissatisfaction with the free balloon as an aeronautical machine, and a growing belief that mechanical flight would ultimately afford a possible alternative, gave rise to the foundation in January 1866 of the 'Aeronautical Society of Great Britain'. Its inception sprang from suggestions—based on the achievements of machines 'capable of floating in the atmosphere'—that 'the balloon should be used only as a buoyant auxiliary, and that mechanical means should be added to produce ascent and descent at will', put forward by F. W. Brearey (on the advice of James Glaisher) at a meeting of the British Association at Birmingham in the previous year.[1] A preliminary circular was issued stating that 'To foster and develope the Science of Aeronautics, which has stagnated for so many years, and incidentally therewith to increase our knowledge of Aerology, are objects of this Society'. On January 12, 1866, the formation of the Society was discussed by a small gathering of six men interested in scientific and mechanical problems, at the residence of the Duke of Argyll, when Glaisher read a short address on the unsatisfactory conditions of aeronautics (more particularly of ballooning), and outlined the main objects it would be the aim of the Society to achieve. The First Council meeting was held exactly a month later, the Duke of Argyll (1823–1900) being elected first President, James Glaisher, Honorary Treasurer, and F. W. Brearey, Honorary Secretary. Within a year the Council included Sir Charles Tilston Bright (1832–88), the distinguished telegraph engineer, Dr. (afterwards Sir William) Fairbairn (1789–1874), an engineer of distinction, H. W. Diamond (1809–86), Secretary to the London Photographic Society, and Christopher Hatton Turnor, of Stoke Rochford, Grantham, best known as the author of *Astra Castra*, as well as Glaisher and Wenham. Further evidence of the support which the Society received at the outset is afforded by the names of early members, amongst others, H. G. Bohn (1796–1884), a bookseller and publisher of remarkable ability; Sir James Brunlees (1816–92), a railway engineer and constructor of Avonmouth Dock; John T. Delane (1817–79), editor of *The Times*; Sir William Siemens (1823–83), already distinguished for his electrical inventions and an F.R.S.; Paul Haenlein (1835–1905), a German

Foundation of the Aeronautical Society, 1866.

[1] *Aeronaut. Soc. Report* for 1866, p. 67. Cf. paper read [before the Aeronaut. Soc.] by Fred. W. Brearey, at a Council Meeting on Feb. 28, 1866, a copy of which is in the Society's library.

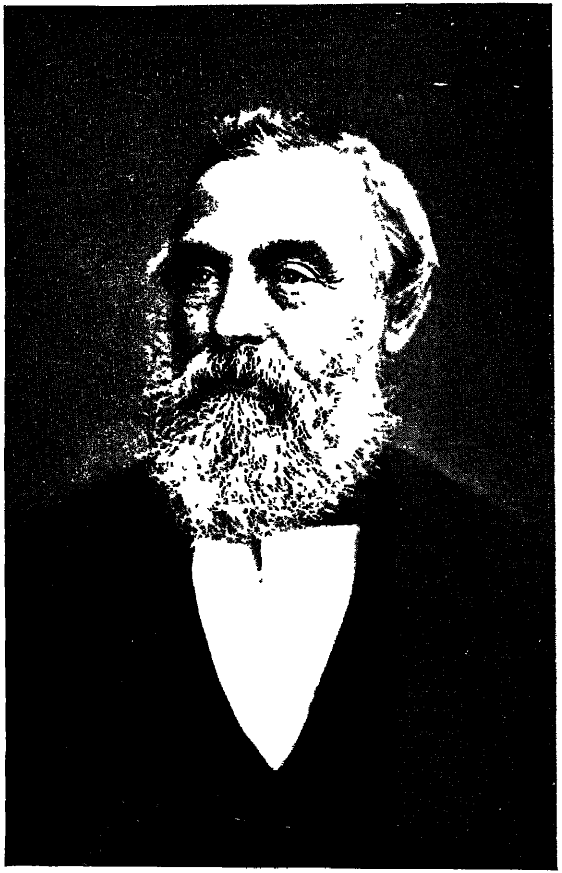


Fig. 102 HENRY COXWELL.

Fig. 103. JAMES GLAISHER.

engineer, and designer (in later years) of the first German motor-driven airship; and James Nasmyth (1808–90), the inventor of the steam-hammer.[1]

The first meeting of members took place on June 27 following, at the Royal Society of Arts—an institution which has ever since honourably accorded to the Aeronautical Society the use of its lecture-room in the Adelphi. The occasion was historic for two reasons, first as marking the beginnings of the earliest scientific organization in this country devoted to aeronautics, and second by reason of the reading of Wenham's epoch-making paper on 'Aërial Locomotion'. But before that paper was given the aims of the Society were briefly explained by Brearey, who had been appointed the first Honorary Secretary. Inasmuch as its foundation and early achievements were mainly due to Brearey's enthusiasm and energy, it is fitting that some account should be given of his life and aeronautical endeavours. The First Meeting, June 27, 1866.

Frederick William Brearey was born at Stillingfleet, near Scarborough, in 1816. His father was a friend of Sir George Cayley, and witnessed some of the experiments with flying machines made by Cayley at Brompton Hall—a fact to which Brearey quite probably owed his own interest in the science, though, as he himself recorded, it was considerably later in life that he first heard of them.[2] Indeed, it was not until the foundation of the Aeronautical Society in 1866, and his immediate appointment as Honorary Secretary—a post which he filled up to the time of his death—that his proclivities found full scope. Thereafter he threw himself wholeheartedly into the work of the Society, conducting a large correspondence and himself reading many papers, besides giving numerous lectures throughout the country, at which he exhibited mechanical flying models of his own design. His labours called forth from Octave Chanute in 1882 a well-deserved tribute to Brearey's 'long-continued experiments', and his influence in having cleared away 'much rubbish, and placed [the subject] on a scientific and firm basis'.[3] While Brearey's original views in favour of mechanical flight were apparent in the remark which gave rise to the Society, they became much more pronounced in later F. W. Brearey, (1816–96). His Faith in Mechanical Flight.

[1] Haenlein took out a patent in this country for his 'Navigable Balloon'. See Brewer and Alexander, p. 32, no. 930, 1865.

[2] *Aeronaut. Journal*, no. 1, January 1897, p. 9.

[3] It is said that Brearey wrote a book on *The Atmosphere as a Medium of Travel*, but if so it was never published.

years, as is sufficiently shown by 'A paper in Condemnation of Gas as an aid to Aërial Machines', which he read in June 1880.[1] As time progressed and knowledge accumulated Brearey's faith in mechanical flight became ever stronger, and towards the close of his life his experience and knowledge of mechanically propelled 'aeroplane' models led him to look for success from the experiments of Sir Hiram Maxim and H. F. Phillips—both members of the Society. Indeed, they had in his view only come short of actual achievement in that their respective machines had not 'come under control when set free in the air'. 'Then', said Brearey, 'will come the real test, and the real danger; but, that success will be ultimately achieved, who that considers man's pluck, luck, and perseverance, can doubt?'

His Death, Jan. 31, 1896.

With increasing age his energies abated, and the activities of the Aeronautical Society suffered accordingly. But he struggled to keep it alive, and it is to his honour that he succeeded in doing so up to his death in January 1896. Moreover, only two months before that date a fresh wave of enthusiasm—incited by the experiments with Maxim's great machine, Lilienthal's soaring flights in Germany, and the publication in 1894 of Chanute's *Progress in Flying Machines*—had caught up the Society, which entered therefrom on a renewed career that has done honour to the indefatigable labours of its first Honorary Secretary.

F. H. Wenham, 1824–1908.

Returning to the first meeting of members on June 27, 1866, it must be said that the reader of the first paper, Francis Herbert Wenham, though hardly less active than Brearey in furthering the interests of the Society, was a bigger man in the breadth and character of his aeronautical ideas. Wenham was born in Kensington in 1824, and at an early age gave promise of an interest in mechanical problems to which, as it proved, his life was devoted. In 1841 he joined a firm of marine engineers at Bristol and showed his ability in some independent work on tubular boilers, one of which (designed by him) gave excellent results and was in 1853 built into a small yacht. In this vessel Wenham steamed up the Nile as far as the second cataract in 1858—a trip that afforded him ample opportunities for those close observations on bird-

[1] See *Aeronaut. Soc. Report* for 1880, p. 26. Otto Lilienthal, who joined the society in 1868, expressed the view (in about 1890) that the balloon had been actually an 'obstacle' to the development of flight, and he regretted the fruitless expenditure of ingenuity and money on the former. See Lilienthal (O.), *Birdflight as the Basis of Aviation*, by A. W. Isenthal, 1911.

FIG 104 FRANCIS HERBERT WENHAM

FIG 105 FREDERICK WILLIAM BREAREY
First Secretary of the Aeronautical Society of Great Britain

flight, which directed his mind to kindred aeronautical problems, and on which the ideas he developed (with marked independence) were largely based. On returning from Egypt he worked out his ideas and wrote the classic treatise which, seven years later, he read before the Society under the title of 'Aërial Locomotion and the Laws by which Heavy Bodies impelled through Air are sustained'.[1] At a later date he constructed, for use in his aeronautical experiments, the first light gas-engine in this country, and in 1871–2 he undertook in conjunction with John Browning, the first experimental work—on the testing of planes to determine the connexion between pressure and velocity—initiated by the Aeronautical Society. Though his interests were varied—he was at one time vice-president of the Royal Microscopical Society, and engaged in photography and other branches of optics—it is evident that aviation continued to occupy his mind during the latter years of his life. In August 1893 he read a paper entitled 'Suggestions and Experiments for the construction of Aerial Machines', before the (second) International Congress held in Chicago, with Octave Chanute as chairman.[2] In 1900 Wenham contributed to the *Aeronautical Journal* a short paper on 'Forms of Surfaces impelled through Air and their Effects in Sustaining Weight', in which it is notable that although thirty-four apparently fruitless years had passed since he read the paper on which his fame rests—and Wenham expressly states that he had 'only occasionally reverted to the subject' in the interim—yet he refused to be 'convinced that flight is impossible for man'. In 1908 he wrote a last contribution for the same journal, and died at Folkestone on August 11th of the same year.

His Observations on Bird-flight, 1858.

His Aeronautical Experiments.

His Death, Aug. 11, 1908.

Wenham as a Pioneer of Aviation.

Wenham's theoretical writings, based as they were—though not, of course, without a modicum of error—on independent observations, reasoning, and experiments, are sufficiently accessible to render any full analysis here unnecessary. But it has been truly said that his enthusiastic devotion to the cause of artificial (that is mechanical) flight, gave it an impulse to which is directly traceable the aeroplane as we know it to-day, and it is therefore desirable to

[1] Aerial Locomotion [by F. H. Wenham] from the *Transactions* of the Aeronaut. Soc. of Great Britain [being the first *Annual Report* for 1866]. The paper was reprinted by the Society as No. 2 of the *Aeronaut. Classics*, 1910, edited with a biographical notice by T. O'B. Hubbard and J. H. Ledeboer, to which the present writer is indebted for the details above. It had previously been reprinted by Means, 1895, p. 82, &c.

[2] *Proceedings of the International Conference on Aerial Navigation*, held in Chicago, Aug. 1–4, 1893, New York, 1894, p. 297. The first International Congress on aeronautics was held at Paris in 1889.

state briefly the essential features of his work. The outstanding merit and importance of Wenham's work as a pioneer of aviation lies in his clear understanding, and equally clear exposition, of the fact that the basis of mechanical flight was the resistance offered by the air to bodies moving in it. Though he sought to arrive at sound principles by the help of observations on bird-flight—in which connexion he was largely instrumental in destroying the common delusion as to air-cells in birds—he was not misled, as many others had been before him, into attempting to copy nature. He realized that there must be a certain proportion between the air-borne surface and the weight sustained—his basis was one square foot of surface for every pound; he knew that extreme lightness was not an essential factor, and he formed the opinion that flight would not necessitate as much power as was generally thought.[1] In this connexion, while he realized the all-important factor of a 'first mover'—his own experiments on gas-engines were directed to that end—he was unable to see the practicability of any known arrangement as a successful solution, though he went so far as to assert that the air-screw was in all respects perfect as a propeller for aerial machines. But in his last contribution to the *Aeronautical Journal* (already mentioned), he gave it as his belief that 'a gliding machine capable of carrying a man should be so far perfected as to obtain the longest flight possible'. 'The great difficulty', he significantly added, 'yet to be overcome is that of equilibrium during flight.'[2]

His experiments enabled him to enunciate clearly and for the first time, the theory that inclined surfaces moving rapidly through the air are supported mainly by the front (or 'leading') portion of the surface, and this in turn led him to suggest that 'aeroplanes' must be long and narrow: that is to say, the 'aspect ratio' of the plane—the proportion of the length (or, in modern terminology, span) of the wing, to its breadth (or chord)—must be high. Furthermore, he went so far as to declare that the 'whole secret and success in flight depends upon a proper concave form of the supporting surface', thus anticipating the cambered wing.[3] The further

[1] See Langley (S. P.), *Experiments in Aerodynamics*, 1891, wherein the truth of Wenham's opinion as to power was confirmed by data resulting from much careful experimental work with model flying machines. Cf. also *post*, Ch XV, p. 346.

[2] *Aeronaut. Journal*, vol. iv, 1900, p. 134.

[3] It was not until 1884 that the idea of a cambered wing was definitely formulated by H. F. Phillips in a patent specification as an invention for use in aerial machines. See p. 284 *post*. Also Abridgments of Specifications, *Aeronautics*, 1884, no. 13,768.

suggestion as to superposed planes had previously been made by Cayley, with whose work Wenham was to some extent acquainted. Throughout his investigations he insisted—on lines which differentiate his work from all earlier pioneers, save only Cayley—that experimental data was essential to true progress, and he set an example of scientific thoroughness in attempting himself to supply such data—as for instance in his discussions on the 'lift' and 'thrust' forces exerted by air pressure on 'inclined planes' (printed in the Society's Sixth Annual Report, 1871), and his observations on the 'slip' of the air-screw.[1] Finally his mechanical knowledge and sound critical judgement—qualities tempered always by reason and moderation—enabled him to forward the science of aeronautics not less by the solid value of his own contributions than by the enthusiasm he evoked in the cause of flight. As it has been finely said, we may be sure that when the aeronautical history of the era in which he worked 'has become veiled with the dim twilight of half-forgotten things, the figure of Wenham will stand out clear and strong above the deepening shadows'.

Aeronautical Society's Reports, 1866–93.

Reviewing the early years of the Society's history at large, it may be claimed that its most important achievement was the publication of Annual Reports on the work done year by year—a feature noticeably lacking in previous periods of aeronautical endeavour.[2] These reports are in the main abstracts of the papers read and the discussions arising thereon, and they undoubtedly constitute a valuable body of knowledge—historical and technical—over the period of nearly thirty years during which they were published.[3] Obviously, having regard to the state of aeronautical science of the period, a number of the papers are the valueless contributions of mere enthusiasts, but the reasoned criticisms of Glaisher, Wenham, and Thomas Moy, seldom failed to expose the fallacies of 'cranky' inventors.

[1] 'Lift' denotes the reaction of the air pressure tending to raise the plane; and 'thrust'—or as it is now termed 'drag'—the pressure which retards the forward motion. Langley used 'lift' and 'drift', but Wenham certainly introduced the former term much earlier. Cf. Raleigh (W.), *The War in the Air*, 1922, vol. i, p. 54.

[2] The *Reports* were published annually from 1866 to 1882, and continued irregularly to 1893. They were superseded in January 1897 by the publication of *The Aëronautical Journal*, in the title of which the 'damned dots'—to adapt Lord Randolph Churchill's *mot* as to decimals—over the second vowel were dropped, to be unnecessarily restored, however, from volume vi, 1902, onwards. The society received the distinction of 'Royal' in June 1918, and the title of the *Aeronautical Journal* was changed to *Journal of the Royal Aeronautical Society* in January 1923.

[3] See Appendix II for a list of the more important papers.

Thomas Moy.

The name of Thomas Moy as an ardent supporter of the Aeronautical Society and one of the strongest advocates of mechanical flight during the latter half of the nineteenth century, deserves something more than passing notice. Of his life—save for his keen interest in aeronautics—nothing is known beyond the fact that he was an engineering draughtsman and the inventor of light steam boilers and engines, and occupied his later life with work as a patent agent. Though it was not until 1870 that his name appears as a member of the Society, his first remarks on flight from the mechanical point of view were made on the occasion of a meeting at the Crystal Palace on June 29, 1868. 'We want to fly', he said, in the curt way characteristic of his utterances, 'can it be done? In order to ascertain that, they must go to the A B C of the air. What were the qualities of the air? If a thing moved slowly through the air there is no perceptible pressure, but if it be moved fast, there is immense pressure. The pressure of the air increases as the square of the velocity'—on the strength of which statements he urged his hearers, with a boldness that far exceeded any earlier conceptions of flying speed, to think of nothing less than 150 miles an hour as a speed sufficient for their purpose. Moy's views are the more interesting in that (as he tells us) from 1847 to 1859 he was a believer in the 'displacement theory', or 'lighter-than-air' method of aerial navigation. But rapid strides made in the development of the steam-engine led him to think that Henson and Stringfellow might have succeeded with 'aeroplanes', had more power for weight been available. In 1865 the Duke of Argyll's *Reign of Law* led him, after much thought on the subject of power-driven inclined planes, to abandon gas, and thereafter he became as confirmed an advocate of mechanical flight as he was severely critical of the 'gas-bag'.

Moy and Shill's 'Aerial Steamer', 1869–75.

In 1868 he worked hard, in conjunction with R. E. Shill, on the invention of a light steam-engine with a tubular boiler—he averred when exhibiting his working model before the Society in 1873, that he could get 'the weight down to 7 lb. per horse-power'—and by 1869 he had settled the main features of his so-called 'Aerial Steamer'.[1] After much labour in experiments and reconstruction, involving long-drawn delay, a large model of the machine

[1] See Patents for Inventions: Abridgments of Specifications, Aeronautics, 1871, no. 3238, and 1874, no. 2808. In 1877 Moy also took out a patent (no. 1406) for a single-acting engine with a water-tube boiler for aeronautical (or other) purposes. At the Aeronautical Exhibition of 1868 Shill exhibited a small steam turbine engine.

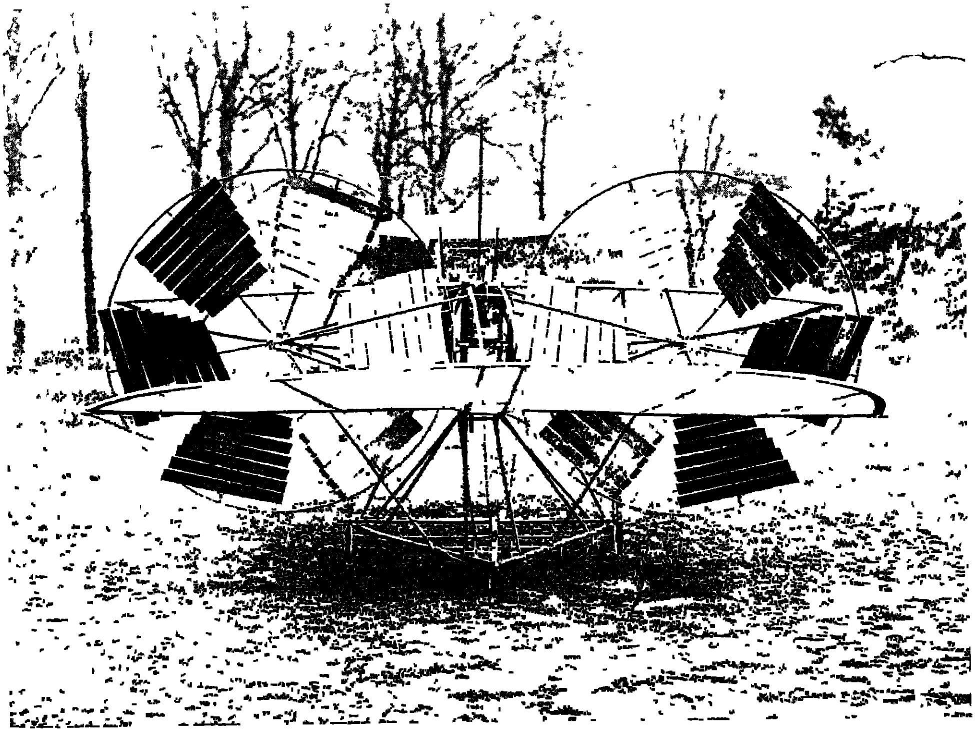


FIG 106 MOY'S AERIAL STEAMER, experimented with at the Crystal Palace, Sydenham, 1875

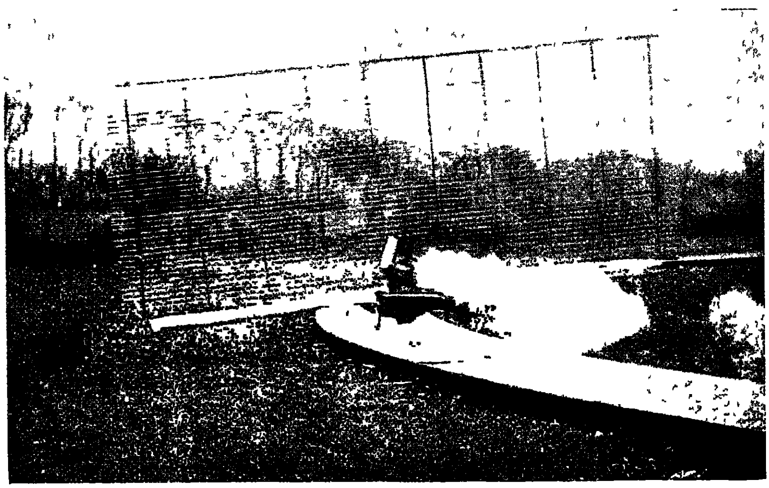


FIG 107 HORATIO PHILLIPS' FLYING MACHINE IN MOTION (rear view)
Tested at Cogswell and Harrison's Gun Factory, Harrow, 1893.

was eventually erected during 1874, and tested on a circular track round one of the fountains at the Crystal Palace. In the main Moy's ' Aerial Steamer ' consisted of two ' fixed aeroplanes ', fore and aft, set at an angle of 10°, and affording a surface of 114 square feet. Between the planes were two 6-feet ' aeroplane wheels ' both of which had ' twelve light wooden planes fitted to them somewhat like screw propellers '—or more truly like the sails of a windmill—these two wheels being driven through frictional gearing by a three horse-power engine weighing 80 lb. The whole model, running on three small wheels, was built up of bamboo canes and diagonal wire bracing, and during the first six months of 1875 (the ' aeroplane wheels ' having been increased to 16 feet diameter) it was tested in the presence of the Duke of Argyll, F. W. Brearey, and others (Fig. 106). According to the independent evidence of a careful observer, on one occasion in June 1875 the machine (despite the fact that the engine failed to give the speed Moy anticipated) rose from 2 to 6 inches clear of the ground—a small achievement for so great an expenditure of effort, but one which (regarded together with earlier trials) justified Moy in claiming that his model ' Aerial Steamer ' was the first ' machine weighing 2 cwt. [that] had ever been driven by its own motive power by revolving planes impinging on the air ', and the first, also, to demonstrate the possibility of flying by steam, inasmuch as his three horse-power engine had lifted 120 lb., the total weight of the machine.[1] Though Moy discontinued (doubtless for financial reasons) his experiments on the larger scale, he persevered for several years in conducting investigations into aerodynamic factors bearing on the properties of air-screws and planes. In 1879 he arrived at conclusions as to the centre of pressure under a plane, which confirmed the view first urged by Wenham as to the importance of narrow planes. On these lines he constructed a model aeroplane (with fore and aft wings) to be propelled by twin tractor screws, with motive power derived from twisted rubber, the strength of which, however, proved insufficient for successful flight. At a later date he evidently came to realize the importance of stability in aerial machines, and in connexion therewith he took out a patent (1891, No. 14,742) for an automatic mechanical device designed to control planes or rudders by means of the action of a pendulum. But the value of Moy's work as a whole lay in his persistent advocacy of endeavours

Moy's Later Work with Models.

[1] *Aeronaut. Soc. Reports* for 1873 (pp. 81–2), 1874 (pp. 69–74, with a woodcut of the machine), and 1875 (pp. 6–16). Cf. also *Report* for 1878, p. 8. The model was eventually destroyed in a rough wind.

to arrive at the basic factors involved in mechanical flight—a work to which he unselfishly applied a great amount of work and no inconsiderable part of his means. Moreover, as aforesaid, the stalwart support he gave to the Aeronautical Society in days when mechanical flight was commonly regarded as the futile hobby of unscientific—not to say deluded—enthusiasts, entitled Moy to a modest place with the modern pioneers of aeronautical science and technology.

Looking back to the general 'aeronautical atmosphere' (so to speak) in which the work of the Society had at this period to be carried on, it is evident that the commonly prevailing impression of the futility of many schemes put forward, had engendered a prejudice which affected aversely any appreciation of sound scientific theorizing. 'Under ordinary circumstances', said the *Morning Herald* in an article on the foundation of the Society, 'we should be disposed to pay very little attention to any scheme for proposing or considering this subject, as hitherto almost all attempts in this direction have been made by visionaries ignorant of the most essential primary principles of pneumatics or mechanics'.[1] Such fallacies, in physics and mathematics, even more than in mechanics, led to the realization of a need for experimental work of a fundamental kind, and with that object the Society arranged a series of experiments with an instrument designed by Wenham, for obtaining data 'with respect to the Action of a current of air upon inclined planes of necessarily limited area but varying angles'. These experiments—undertaken at Penn's Engineering Works at Greenwich—were carried out by means of a fan blower directing a current of air through a trunk about 10 feet long, the 'plane' being fixed to a horizontal arm—probably the earliest recorded use of a 'wind channel' for aerodynamic experiments. The data of the 'lift' and 'thrust' ratio thus obtained were subsequently published in the Report for 1871.

Aeronautical Society's Experiments in Aerodynamics, 1871,

Three years earlier the Society, at the instigation of the Secretary, and encouraged by the interest manifested in its proceedings, held the first Aeronautical Exhibition arranged in this country (Fig. 108). It was opened at the Crystal Palace, Syden-

and Exhibition at the Crystal Palace, 1868.

[1] *Morning Herald*, Jan. 18, 1866. *The Times* (Jan. 16) merely announced the formation of the Society without any comment. The *Daily Telegraph*, at a somewhat later date—during the Society's exhibition in 1868—adopted a typical attitude of complete scepticism, and compared their complaint against 'flying philosophers' to that of boys against 'the proprietors of donkeys which are announced to ascend a ladder. The donkey never really does go up—and the philosopher has not yet flown'.

ILLUSTRATED TIMES

No 694—Vol xiii — SATURDAY, JULY 4, 1868 — Price 3d—Stamped 4d

THE LORDS' DEBATE ON THE IRISH CHURCH

The Lords have done what everyone expected them to do they have thrown out, by a majority of two to one, the Irish Church Temporalities Suspensory Bill, and that after—for their Lordships—an unusually lengthened debate and an extraordinarily numerous muster Hereditary wisdom has shown that it is not altogether effete but that it can rouse and exert itself on occasion however slight may be the influence of the effort on the ultimate course of events. Their Lordships, by the division on Monday night, have done two things, and no more they have made it possible for a few more vested interests to be created in connection with the Irish Church and they have recorded their determination to uphold—as long as they can—the injustice of an alien Church in Ireland that is, they have declared their approval of the existence of an insulting ascendancy of the few over the many, and the propriety of taxing the adherents of one creed for the support of the ministers of another That is the full extent of their Lordships achievement so far as it has a direct bearing on the question at issue and we respectfully submit that it is not much

The fate of the Irish Establishment has now been referred to another tribunal—that of British public opinion, and if, as we believe they will, the people of Great Britain and Ireland shall at the polling booths indorse the policy of the House of Commons and repudiate that of the Lords Spiritual and Temporal the final result will in no way be affected by the vote of Monday night Their Lordships have been pretty well accustomed of late years to practise the art

THE AERONAUTICAL SOCIETY'S EXHIBITION AT THE CRYSTAL PALACE

Fig. 108. THE FIRST AERONAUTICAL EXHIBITION HELD IN ENGLAND, CRYSTAL PALACE, SYDENHAM, JUNE 1868.

ham, on June 25, 1868, and eight following days, and comprised seventy-seven exhibits, including light engines, models, both lighter- and heavier-than-air (mostly designed to be propelled by screws or fans, and with some of which working demonstrations were given),

FIRST EXHIBITION

OF THE

Aeronautical Society of Great Britain,

PREPARATORY TO AN EXHIBITION UPON A LARGE SCALE IN 1869

CATALOGUE.

LIGHT ENGINES AND MACHINES in the BASEMENT
MODELS, DRAWINGS, &c, in the NAVE.
KITES FOR EXPERIMENTS, OUT OF DOORS
MORTAR FOR EXPERIMENTS, OUT OF DOORS
WORKING MODELS NOT REQUIRING STEAM, in the NAVE,
Except under special consideration.
WORKING MODEL WITH STEAM, in the BASEMENT

EXPERIMENTS IN ONE OR OTHER OF THE LOCALITIES WILL BE GOING ON THROUGHOUT THE DAY

Written Notices will be found in each Department

THE KITE EXPERIMENTS MUST DEPEND UPON THE WIND

THE BALLOON "CAPTIF"

WILL MAKE

REPEATED ASCENTS TO THE HEIGHT OF 1000 FEET,

Which will embrace a view of one tenth of the whole of England

MEMBERS ADMITTED FREE TO PALACE AND BALLOON

Mr Delamarne's charges for Ascents are entirely independent of the Aeronautical Society

JAMES GLAISHER, F.R.S., WILL ASCEND DURING THE NINE DAYS FOR METEOROLOGICAL PURPOSES.

ROBERT K BURT, PRINTER, WINE OFFICE COURT, FLEET STREET, AND CRYSTAL PALACE SYDENHAM

Fig. 109.

kites, and plans of aerial machines. About half-a-dozen prizes were offered, the largest being £100 from the Society for the lightest engine—in proportion to its power—for aerial purposes, which was awarded to John Stringfellow 'for his engine and boiler of one horse-power'.[1] A more modest prize of £50 was offered by the Crystal Palace Company for a machine to be driven by steam

[1] See Ch. XV, p. 360.

or other motive power, 'which shall sustain and move itself in the air, at a height of not less than 10 feet for a period of not less than 5 minutes'. No award was issued in this respect for, as the promoters pointed out, 'any machine which should fly for five minutes would be quite out of the bounds of the Crystal Palace, and perhaps many miles away'.[1] Broadly speaking the Exhibition may be said to have been successful, though a suggestion to repeat it the year following was allowed to fall through.[2]

The Theory of Mechanical Flight, 1866–80.

For the next ten years and more the Society continued to do useful spade work, which is reflected in the pages of the Reports. Though its membership was never much more than one hundred and gradually declined to about thirty, the enthusiasm of a handful of prominent members—notably Glaisher (who for many years occupied the chair at the meetings, and whose scientific attainments were of great service), Wenham, and Thomas Moy (whose work has been already discussed), F. D. Artingstall of Manchester (with experience in experimental aeronautics dating back in the 'thirties'), Dr. W. Smyth, D. S. Brown, James Armour, and Horatio Phillips—steadily built up the prestige of the Society.

Experimental Work of Horatio Phillips, 1884–93.

Of these the latter is destined to be longest remembered by reason of his invention known as the 'Phillips entry', in respect of aero-curves. After more than twenty-five years of study and experiment—during which he tested air-pressures by means of artificial currents produced in an early form of 'wind-tunnel'—Phillips, having demonstrated that flat planes were useless for supporting weight in the air, took out a patent in 1884 for a series of blades of curved section, designed to increase the supporting effect of the air-pressure on the concave under-surface. This principle he adopted in a large model machine, the sustaining surface of which consisted of a number of superposed wooden slats—about 19 feet long and 1½ inch wide, in the form of a Venetian blind—which was driven round a circular track by a steam-engine actuating a two-bladed propeller. As in experiments made by Victor Tatin, the machine was kept to the track by wires carried to a central mast, but

[1] The Crystal Palace Company first suggested twenty minutes as the period of flight, but this was altered at the request of the Aeronautical Society. See *Catalogue of the First Exhibition of the Aeronaut. Soc. of Great Britain*, 23 pp. (in the Cuthbert Collection). A report on the exhibition was printed in the society's *Third Report* for 1868.

[2] In June, 1885, another Aeronautical Exhibition was held by the Society, during the International Exhibition at Alexandra Palace.

when driven at a speed of 40 miles per hour it rose 3 feet in the air, and was thus sustained for two or more complete circuits. This success was achieved in May 1893 on a track (628 feet in circumference) laid down in the grounds of Messrs Cogswell and Harrison's gun factory at Harrow (Fig. 107). Though no attention was paid to the vital question of stability, and though the measure of success—the tethered flight through the air of a model machine, lifting no more than 3 feet from the ground for about 1,000 feet—may well have seemed a trifling reward for many years of labour, nevertheless it was a highly significant achievement and entitles Horatio Phillips to rank among the true pioneers of mechanical flight.[1]

Between 1870 and 1880 only one meeting of the Aeronautical Society was held each year, but several papers were read on each occasion.[2] Many of these were concerned with the various aspects of bird or ornithopter flight, which continued as of old (usefully up to a certain point) to occupy the minds of many would-be pioneers, though, as Glaisher remarked in 1873, the idea of man flying by muscular power had long been given up. From these ornithological observations of a highly contentious character and often misleading in so far as they involved attempts to imitate nature, attention was increasingly turned to aerodynamic aspects—in particular the subject of air-pressures on inclined planes or 'aeroplanes', the latter term at that time used to signify a 'plane placed in the air for aeronautical purposes'.[3] Concurrently the various aspects of the screw propeller—slip, variable pitch, and so forth—were the object of countless experiments, which soon revealed—at least to men of the calibre of Wenham—that although of questionable use in a helicopter machine, it was 'perfect as a propeller for aerial machines'.[4]

With regard to the development of balloons, in the early days Navigable Balloons

[1] Chanute devotes several pages (166–72) to an account of H. F Phillips's experimental work See also *Engineering*, Mar 10, May 5 and 19, 1893, *The Times*, May 24, 1893, and Patent Abridgments, Nos 13,768, 1884; 20,435, 1890; and 13,311, 1891.

[2] In May 1876 a club was started in conjunction with the Society, and its members used to meet Brearey once a month during the session for informal discussions (*Report* for 1878, p. 6).

[3] The quotation is the only meaning given in the *N. E. D.*, and the only example of its use is taken from the *English Mechanic*, June 4, 1869. The word was, however, used (within inverted commas) by F. H. Wenham in his paper on 'Aerial Locomotion', 1866. A few years later the meaning advanced nearer to its present-day sense—as seen in a paper on 'The Aéroplane: its construction, stability and means of propulsion', by D. S. Brown, June 1873, *Report* for 1873, p. 13.

[4] *Aeronaut. Soc. Report* for 1867, p. 25.

of the Society's career they largely occupied the attention of theoretically inventive minds, to be displaced after the first year or two by the problems of mechanical flight. Owing to the notable use made of balloons during the siege of Paris in 1871, and the remarkable experiments of Dupuy de Lôme which followed, interest was reawakened, and in the Society's Report for that year it is recorded that two-thirds of the designs submitted were concerned with navigable balloons. But with two such avowed and active enemies of ' aerostation ' as Brearey and Moy this aspect of aeronautics was hardly likely to receive adequate consideration, while the prohibitive expense of attempting any sort of experiments on a useful scale remained as ever a serious obstacle to progress.[1] It is true that the writer of an article in the *Quarterly Review* during 1875 advocated the ' dirigible balloon ' as exemplified in the actual achievements of Dupuy de Lôme, and contrariwise derided the *plus lourd que l'air* doctrine as ' only an idea '.[2] But in the first ten or fifteen years of the Society's Reports there are comparatively few papers of note on any aspects of the principle of the balloon, either free or navigable. Perhaps the most notable exception was a discussion on Meusnier's *Memoir upon the Equilibrium of Aerostatic Machines,* which appeared in 1879—a year in which the ' Concluding Remarks ' of the Report (doubtless drawn up by Brearey) referred contemptuously to the fact that ' Balloons have again come to the front ', and dismissed all such aeronautical machines with the obviously biased, not to say short-sighted, remark that the merest tyro ought to be convinced that ' gas bags, gas cylinders, fish-shaped gas vessels, &c., &c., can never be driven at an appreciable speed '.

Meanwhile, despite Brearey's advancing age and the increasing inanition of the Society's activities, ' rubbish ' (to use Chanute's

[1] See *Aeronaut. Soc. Report* for 1880, p. 23, &c., where the attitude of the society towards ballooning and flight was discussed and defined by the chairman W. H. Le Feuvre.

[2] *Quarterly Review,* vol. cxxxix, 1875, p. 105. Moy wrote a vigorous reply, in which (as events have proved) he showed as great a lack of understanding in respect of airship theory, as he undoubtedly possessed of mechanical flight. See *Aeronaut. Report* for 1876, p. 21. Incidentally it may be remarked that the article referred to in the *Quarterly Review* [written by William Pole] was the only one published since its commencement in 1809. Its rival the *Edinburgh* equally avoided the subject, for though it commented in 1819 (no. 64, p. 367) on the balloon as ' most characteristically a French invention; showy, enterprising, holding out to unstaid imaginations, a hope of utility, of which philosophy could easily demonstrate the folly ', it published no article on aeronautics prior to April 1903 (no. 404, p. 323).

expression) was being tediously sifted out and a body of scientific data collected, which at least sufficed to indicate the more profitable lines for further experiments and research. As remarked elsewhere a solution of the problems involved in the stability and propulsion of aeroplanes, and likewise in the power required for the propulsion of airships, was at this period (towards the close of the nineteenth century and therefore beyond the scope of the present work) the essential desideratum. That solution came, in the former respect, with the gliding experiments of the Lilienthals, Percy Pilcher, the Wrights, and other great pioneers of flight, and in the latter with the development of the internal-combustion engine. But the Royal Aeronautical Society has lived to see the accomplishment in full measure of its aims in advancing the science of aerial navigation, and though it is still doing and will assuredly continue to do useful work in maintaining the prestige of British Aeronautical science, it may justly look back with pride and satisfaction to its achievements in those earlier days, when the common attitude of aggressive scepticism towards flight might have been contemptuously expressed in the old proverb, 'Pigs might fly if they had wings'.

It is, indeed, remarkable to reflect that there are men living to-day who can bear witness from personal experience in the near past, to that widespread opinion which regarded mechanical flight with incredulity and ridicule, and which deemed those who had any faith in the possibility of flight either as amiable cranks or demented enthusiasts. There can be little doubt that this adverse current of public opinion was, to within quite recent times, strong enough to hamper the work of experimentalists and to deter men of scientific attainments from taking an active part in the elucidation of the principles of aeronautics. For that reason the greater is the honour due to those later pioneers of both lighter- and heavier-than-air flight, who, in the face of persistent ridicule and discouragement devoted a large part of their lives and of their means to disinterested endeavours to forward a great idea.

CHAPTER XIII

EARLY ATTEMPTS TO CONTROL BALLOONS AND THE EVOLUTION OF THE AIRSHIP

From the earliest days of the invention of the free balloon, it was apparent man would not rest content until he had learned to navigate his machine in the air with the same facility that sailors navigate a ship at sea. As it was aptly put by an anonymous versifier writing in 1786:

> To Montgolfier the Invention's due,
> Unfinish'd as it lies,
> But his will be the Glory who
> Direction's art supplies.

To have ascended into the air and to have travelled through it were great achievements, but Dr. Johnson, though among the earliest, was not alone in pointing out that unless balloons could be directed, their usefulness must be limited to the point of futility.[1] Indeed, the means of direction was so desirable that from a very early date after the first ascents in France many theoretical designs—notably those of Meusnier—were forthcoming, and contemporary aeronauts (the brothers Robert, and Blanchard, amongst others) endeavoured to put into practice methods of overcoming the difficulties.

By a natural but erroneous process of reasoning the combined use of sails, oars, and rudder was the first form which in England (as abroad) any such ideas assumed. One of the earliest projects was that of Thomas Martyn (fl. 1760–1816), a natural history draughtsman and pamphleteer, who in his *Hints of important uses to be derived from Aerostatic Globes*, published in October 1784, issued a plate of a 'Design', with a prefatory note stating that it was 'similar to one presented . . . to his Royal Highness the Prince of Wales in November, 1783, and to another copy transmitted to the Academy of Sciences at Lyons, in February, 1784' (Fig. 110). Whether the latter was sent in connexion with the prize offered by the

Thomas Martyn's Design, Nov. 1783.

[1] See Ch. IX, p. 198, *ante*.

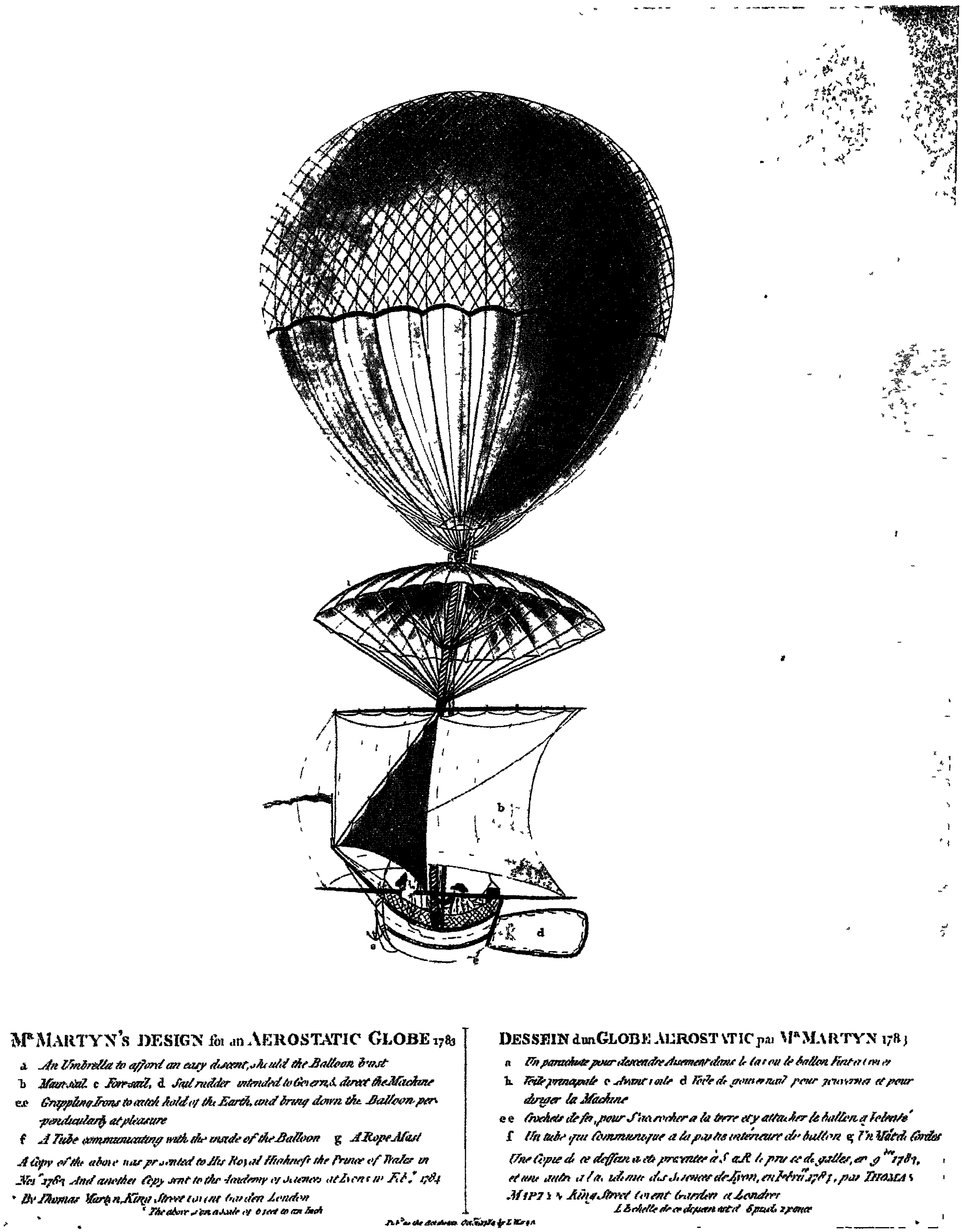


Fig 110 MARTYN'S AEROSTATIC GLOBE, 1783.

The Earliest English Design for a Navigable Balloon.

Academy for the best dissertation on 'the most certain and most simple method of directing the Air-Balloon horizontally and at pleasure', is not known. In any case the design—which incorporated a main-sail and jib made fast to a rope mast, which

HINTS

OF

IMPORTANT USES,

TO BE DERIVED FROM

AEROSTATIC GLOBES.

WITH

A PRINT OF AN AEROSTATIC GLOBE,

AND ITS APPENDAGES.

ORIGINALLY DESIGNED IN 1783.

BY

THOMAS MARTYN.

LONDON,
PRINTED FOR THE AUTHOR
And sold by Mr. WHITE, Fleet-Street, Mr. PAYNE, the Mews-Gate Mr. ROBSON, New-Bond-Street, Mr JOHNSON, N° 72, St Paul's Church-yard, Mr DEBRETT, Piccadilly, and Mr BECKET, Pall-Mall.
MDCCLXXXIV.

Fig. 111.

apparently sustained the boat-shaped car, the latter being fitted with a large 'sail rudder'—was conceived in ignorance of the simple fact that a balloon floating freely in the air, affords no fulcrum for the use of sails, which drift at precisely the same rate as everything else forming part of the balloon. If Martyn had had practical experience he would have found one short voyage sufficed

to demonstrate that his sails would not blow out in the way his engraving so plausibly illustrates. Indeed, a month or so later he was to learn in his controversy with Blanchard that the latter had found sails quite useless, and had, moreover, experienced the fact that a candle will burn quietly in the car of a balloon, even though the balloon itself is being carried rapidly along in the stream of a considerable wind.[1]

The Use of Wings by Blanchard and Lunardi, 1784.

But though Blanchard himself realized well enough the essential difficulty of directing balloons, he persisted during his stay in England in maintaining that by means of oars, and with the help of his 'moulinet' (a primitive form of air-screw), he was able to manœuvre his machine. Doubtless the oars which Lunardi endeavoured to use were copied from Blanchard, but both soon tired, in a practical as well as a literal sense, of trying to work them.[2] Indeed, none of the ideas, theoretical or practical, of English origin or experimented with in England, can be compared with the highly remarkable and scientific designs for a dirigible airship, conceived by Meusnier—designs which (as recorded in the General Survey) go far to justify the claim that he was the 'true inventor of aerial navigation' on the 'lighter-than-air' principle.[3] Nevertheless, a few of the many schemes—mostly quite impracticable, not to say extravagant—which were put forward in this country, may be briefly recorded, if only as testifying to the attraction which the subject had for those of a mechanical or inventive turn of mind.

Impossible Projects:

The earliest recorded attempt to devise mechanism wherewith to direct and control a balloon, appears to be that described in *The Air Balloon*, 1783, as the work of a 'philosopher' who, 'seeing that an *Air Balloon* is at present entirely governed by the wind . . . has added a pair of artificial wings to the body of the Balloon, to be worked by the person who goes up in the basket'.[4] A month or two later (in January 1784) a paragraph in the *General Advertiser* announced that a machine, consisting of four small air-balloons fastened to four small levers—beneath which was a frame to carry the 'flyer'—was in process of construction, and that

[1] Richard Crosbie's slightly earlier idea of deriving a limited measure of dirigibility from the use of sails (both fixed and revolving) is referred to in Ch. VIII, p. 187, *ante*.

[2] The brothers Robert also attempted to use some kind of oars and a rudder in their cylindrical balloon of July 15, 1784.

[3] See General Survey, Part II, p. 30.

[4] *The Air Balloon*, new edition, 1783, p. 34. The machine is referred to as 'now compleated' and ready for trial in the spring, but the writer has not been able to trace any further accounts of either this or the following project.

wings were 'actually fabricating' in London. In December 1784, De la Tour, who claimed to have 'considered the subject of directing Balloons', invited financial assistance for his project from any one who was 'ambitious of being handed down to posterity as the founder of a revolution . . . which must produce more astonishing events, than would arise from the sudden addition of wings to every human being'. Nothing is known of his ideas and it may be admitted that the assurance displayed in his engagement to direct a balloon from place to place, 'let the wind blow from what quarter it will,' has the ring of those too attractive proposals which figure in the 'agony column' of the daily press.[1] Assurance was likewise the note struck by Joseph Binns, of Halifax, who claimed (in August of the following year) to have conducted a 'balloon for twenty miles, in a horizontal direction against the wind', an achievement which he rendered wholly incredible by the unintelligible statement that 'this philosophical phenomenon ascertains the steerage from the immediate and remote power of electric repulsion', which same machinery, he adds, made it possible 'to supply the exhausted gas and raise [the balloon] higher and lower at pleasure'.[2] A more cautious claim, though one equally vague in technical specification, was made by Wells for an invention by which he undertook to direct an air-balloon. The means employed were a 'bar of iron fixed horizontally to the balloon, and a magnet applied to the bar', the magnetic power resulting therefrom giving motion to the balloon, 'if it does not blow very strong'. It was announced that an experiment would be made from the Artillery Company's Ground, but there is no record of it and doubtless it proved futile when—if ever—an endeavour was made to translate theory into practice.[3] Earlier in the year a more definite but equally impracticable notion had been put forward by a writer in the *Morning Post*, who suggested that no better means of giving 'horizontal direction to an Air Balloon' could be found, than 'the repulsive force of gunpowder'—an idea which, combined with the alternative use of steam, was also suggested by Erasmus Darwin in one of the notes to his poem, *The Botanic Garden*, 1791, and was revived from time to time by later inventors.[4] Three years later the project was

De la Tour, Dec. 1784;

Joseph Binns, Aug. 1785;

Wells, Dec. 1783;

[1] News-cutting in Patent Office Collection, vol. x, fo. 17. [2] Ibid.

[3] *General Advertiser*, Dec 20, 1783; also Banks Collection.

[4] E. g. Nye (T.), *Thoughts on Propelling Balloons* [by explosion of rockets], 1852; Quartermain (W.), *Gunpowder as a Motive Power [in] Air Navigation*, 1859; and Pynchon

reviewed in a volume of anonymous essays, by Robert Deverell (1760–1841), entitled *Alter et Idem*, where amongst other reasoned comments the false analogy of the balloon in the air and the boat in the water is clearly stated.[1]

M. Prossor, Mar 1785;

A wholly fantastic project was described in Prossor's *Proposals for making a Grand Aerostatic Machine and Sailing Apparatus, consisting of means of Directing, Depressing and Raising it at Pleasure*, issued in March 1785. Subsequently Prossor issued a description of his machine, designed 'to represent Sir John Falstaff, and to be called the Aerial Colossus', which measured 36 feet high and 69 feet 'round the waist', but his expressed intention of ascending beneath it 'into the Atmosphere, when finished', cannot—to judge from the engraving—have been a possible achievement.[2] Not less absurd was the design of M. Uncles, who—quite in the spirit of Gonsales—aspired to 'merit the name of the First Aerial Charioteer', and who announced in April 1786 that he was constructing a balloon to be drawn by 'four harnessed eagles, perfectly tame, and capable of flying in every direction at their master's will'. The advertisement issued by Uncles in April 1786 has, however, a twofold distinction: first in a clearly stated recognition of the impracticability of trying to steer free balloons owing to the lack of a *point d'appui*, and second in the fact that his machine was a 'vast Fish-formed Balloon', of which it must have been one of the earliest types. In May he announced that nothing prevented an ascent save the unsettled weather, the birds being 'well-practiced'; but the trial was deferred until August, when, although the eagles were ready on the ground at Ranelagh, the inflation proved a fiasco, and the balloon did not even rise from the ground.[3]

M. Uncles, Apr. 1786.

Mackintosh's Aerial Ship, 1835.

But the story of the use of birds as a method of achieving flight—a story to be traced from Lucian, through Godwin's seventeenth-century romance of Gonsales, with his trained 'gansas', down to Uncles and his 'well-practiced' eagles—did not end here.

(E.), *High Explosives in Aerial Navigation* [1894], copies of which are in the Patent Office Library.

[1] Deverell (formerly Pedley, Robert), *Alter et Idem, a New Review*, no. 1, Reading, 1794. Article 11 is entitled 'A Project for directing an Air-balloon'.

[2] Patent Office Collection, vol. viii, fo. 11, and vol. x (Fig. 112).

[3] See ibid., vol. x. See also Wouvermans, p. 10, where Uncles is given as the author of *Thoughts on the Farther Improvement of Aerostation*, 1787, a book the present writer has not seen quoted elsewhere, though the title is the same as in the small treatise attributed to S. Hoole (*post*, p. 295)

FIG 112. PROSSOR'S 'AERIAL COLOSSUS', 1785

Fifty years later the avian notion was revived in the most elaborate form it had ever taken—to become thereafter as extinct in this country as the dodo. In July 1835 Thomas Simmons Mackintosh (whose name appears as a correspondent on aerostation in contemporary mechanical journals), in a letter to the *Morning Advertiser* on the subject of 'navigating air-balloons', having first strongly condemned Lennox's 'Eagle' airship (then being exhibited in London), propounded a scheme of his own.

'There is a mode', he wrote, 'by which balloons may be conducted (in moderate weather) with safety; and certainly this is to be accomplished by having a sufficient number of the larger birds, such as hawks—eagles would do better, if they could be tamed—but perhaps strong pigeons would do very well, and let them be harnessed to the balloon, to draw it along.'

He added that a helm would be of 'some service', though not so much as might be supposed. Mackintosh published a 'Sketch of the Aerial Ship', which shows the balloon formed like the hull of a ship, with an additional frame-work keel—fitted with a fan-shaped rudder at the stern—on either side of which are 'harnessed' eight eagles, immediately controlled or 'driven' by the aeronauts seated in a small car between the two keels.[1]

The naive assurance of many of the projectors in these early days is aptly illustrated in the *Description of Two Aerostatic Machines*, which, though published in London, was probably of French origin. One of these (bearing some resemblance to Martyn's globe) is depicted with a large balloon above filled with gas, and a smaller balloon below filled with air. In the designer's simple language the aeronaut had only to charge the latter with air-bellows, in order 'to descend at pleasure', and by means of a cock empty it and ascend when he thinks proper.[2] Assurance amounting in this case to something like insolence was the note of an otherwise unknown inventor, George Boyd, of whom a portrait (made at the age of twenty-two) was engraved in 1802, whereon he is described as the 'Inventor of Regulators for Steering Balloons'. Boyd appealed through the press for financial support 'To Gentlemen of Fortune and Well-Wishers of an Air-Balloon', in a letter which bears

Boyd's Regulators for Steering Balloons, 1802.

[1] Fig. 113. An early foreign project of this kind was described by J. Kaiserer in *Ueber meine Erfindung einen Luftballon durch Adler zu regieren*, Vienna, 1801. A plate depicts the inventor in his balloon driving (as it were) a pair of harnessed eagles. A copy of this rare book (it was reprinted in 1903) is in the library of the Royal Aeronautical Society. (Lockwood Marsh, no. 65). Cf. La Vaux, no. 59, for a French revival of the idea in 1845.

[2] Patent Office Collection, vol. i, fo. 100.

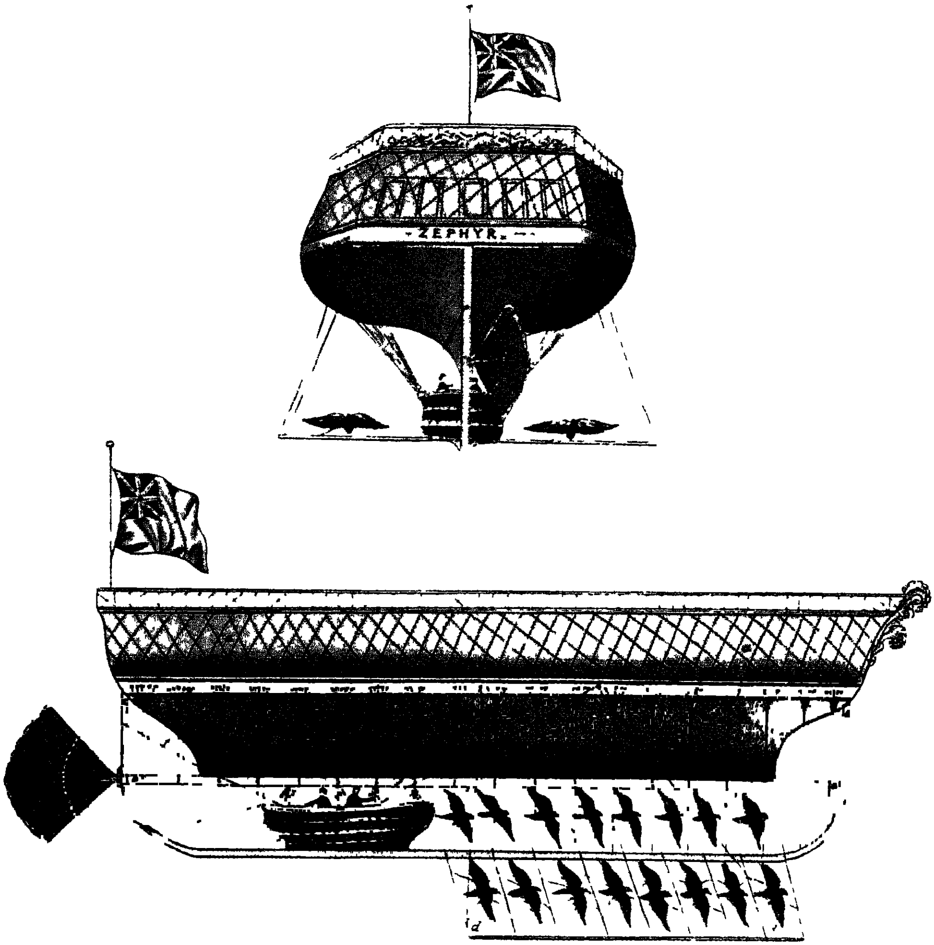
quotation as typical of many other equally specious and infallible inventors:

'Gentlemen, I will undertake to make an instrument to steer an Air-Balloon, and turn it about with ease, to go to any part you please, in spite of a reasonable wind, though men in general, think it impossible, but they who say this, do not consider who is the giver of the idea; this balloon is to rise to any height without throwing out ballast, and descend without letting out air; it will also protect it from the fury of the wind; so that gentlemen of fortune may keep them in their houses to travel with, and cut through the sky with the greatest pleasure that can be imagined. Any gentleman that will step forward and support the small expense that may attend it, may in a little time have the pleasure to see a balloon brought to perfection. . . . Apply concerning it as soon as possible, and gain your country that applause for ingenuity which no other country, perhaps, ever may gain; but trust to my honesty, or I shall not think you worthy to lend a hand. I shall not advertise any more, as this will suffice—Please direct (post paid) for G. B. at No. 22 St. Martin's Lane, and it will be instantly attended to—Gentlemen, I remain your most obedient and very humble servant, G. B.' [1]

But while it is true that the numerous projects for directing balloons proposed in England during the first twenty years following Montgolfier's discovery, came to nought, it is just to allow that at least the more serious designs did help, step by step, to emphasize the character of the problems involved, if only by a negative process of elimination as the result of fruitless experience. It may also be said that for the greater part such designs were a matter of theoretical speculation, not supported on any adequate foundation of experimental work. On the other hand it cannot truly be maintained that the earlier failures led to the abandonment of the idea of the dirigible balloon during the first half of the nineteenth century. It is convenient to date the evolution of the modern airship from the achievement of the French engineer, Henry Giffard, whose spheroidal balloon of 1852 was propelled, with limited success, by means of an air-screw driven by a three horse-power steam-engine.[2] But no adequate account of the subject, even as far as this country is concerned, can pass over in silence such attempts at construction as those described

[1] An impression of the portrait (marked 'private plate') is in the Cuthbert Collection, and on the wide margin is pasted the above-quoted letter from the *Morning Herald*, Aug. 10, 1802.

[2] See *General Survey*, Part II. Hildebrandt (pp. 48–50) skips from 1786 to 1852—thus ignoring Cayley, and in that respect (as in certain errors) is closely followed by Vivian (E. C.) in *A History of Aeronautics*, 1921, Part 3, Aerostatics.



References —a a Body of the Balloon, b Rudder, c Car, d d Bird-frame, e e Frame of the Balloon, f f Rigging of the Rudder, g g Rigging of the Bird-frame

Fig 113 MACKINTOSH'S AERIAL SHIP DRAWN BY EAGLES

1835

by Samuel Hoole in 1785, or undertaken by Pauly and Egg in 1816–17. Moreover, it is misleading to ignore such contributions as those of R. L. Edgeworth in 1816 and—most important of all—the writings of Sir George Cayley at the same period, or his *Practical Remarks* of five-and-twenty years later.

Hoole's 'Flying Fish' (or Oblong) Balloon, 1785.

One of the earliest attempts of a practical kind to construct a navigable balloon in England, is described in a small anonymous treatise entitled *Thoughts on the Farther Improvement of Aerostation*, printed in 1785. According to the ascription of Isaac Reed, the author was Samuel Hoole, whose father (he bore the same name) was a watchmaker and inventive mechanician, his brother, John Hoole (1727–1803), being the translator of Tasso and Ariosto and friend of Samuel Johnson.[1] From the premise that in reasoning on subjects of which there is little actual experience, some guidance may be obtained from analogous matters which are familiar, Hoole suggests that navigation at sea—except as to the use of sails which 'must be entirely rejected'—and the 'great similitude' of air to water, might be usefully considered. He proceeds to discuss the remarks made by Cavallo in his *History* on the shape of balloons, contrivances for directing them, and the ineffectual attempts to use oars made by Blanchard, Lunardi, and Zambeccari. In this connexion he added a note to the effect that Dr. Johnson gave expression to the notion that 'if ever any success was obtained in guiding aerostatic machines, it must be by rowing, and this must be performed by a person well skilled in that exercise'. It may be added that in a letter to the author's brother, John Hoole, Johnson expressed an apparently contrary opinion on the use of wings in directing balloons, as to which he agreed with his friend—'they cannot at all assist it, nor I think regulate the motion'.[2]

Having arrived at the conclusion that 'all the methods hitherto used 'must be abandoned', Hoole describes a machine designed and constructed by himself—and referred to as 'nearly completed'—which embodied totally different principles. From the analogy of the shape of the fish the inventor suggests that the form

[1] [Hoole (S.)], *Thoughts on the Farther Improvement of Aerostation*. . . . By the Inventor of the Machine, 1785. A copy (now in the writer's possession) which belonged in 1803 to Isaac Reed, editor of Shakespeare (1742–1827), bears two notes on the half-title (in Reed's hand), 'This I believe was written by Mr. Hoole [evidently intended for John] and beneath, 'It was by Samuel Hoole his brother'. The copy in the Aeronautical Society's Library has 'S. Hoole' added in writing on the title. Samuel published a volume of *Anecdotes of John Hoole*, his brother, in 1803.

[2] Boswell's *Johnson*, ed. 1887, vol. iv, p. 359.

of the balloon should be oblong 'sharpened at one end in order to divide the resisting air', his idea being to enclose the 'capsula' (or gas-bag) within 'an outer covering of silk'. With the avowed desire of avoiding the use of the French word *ballon* (as meaning ball-shaped or globular), Hoole suggested that the machine should be called the 'Flying Fish'. He answers, or evades, Cavallo's argument as to the difficulty of keeping the head to windward, by the conjecture that 'if the traveller is but tolerably expert' in the use of the two fins and the tail with which the machine was provided, the objection would be overcome. The fins, constructed of 'silk strained over a solid frame', were to be worked by the aeronaut, not from a car suspended beneath the balloon—a position which Hoole conceived would result in waste of energy—but from a seat within the machine itself. There is little doubt that Hoole did actually complete his machine, for there exists a hand-bill announcing the exhibition of it in Cornhill, though there is no record of his having tried it. Nevertheless the project is of interest in so far as it represents an early attempt to convert theory into practice, at least to the point of constructing the machine.[1] That the inventor was not unduly sanguine is seen in the hope expressed at the conclusion of his little book, that in the event of failure it might at least be said of him, '—magnis tamen excidit ausis'.

Sir George Cayley (1773–1857).

Unquestionably the most important contributor to the science of aeronautics—both theoretical and experimental—during the first half of the nineteenth century was Sir George Cayley. Though he has been justly termed the 'Father of British Aeronautics', and though his writings on mechanical flight have been reprinted in recent years, yet the neglect of his contributions to the problems underlying the principles of the airship, justify the contention that the importance of his aeronautical researches has not hitherto been adequately recognized.[2]

[1] Patent Office Collection, vol. ii, fo. 117. The hand-bill describes the machine as made of Persian silk, coloured after nature to resemble a fish 'for the beauty of the spectacle'. Hoole's treatise was on sale at the exhibition.

[2] Hatton Turnor gives no account whatever of Cayley's work, and his name is a notable omission from the *D. N. B.* He is also ignored by Hildebrandt, and though mentioned with great respect by some French writers, his work on navigable balloons is seldom discussed. For the facts here stated the writer is indebted to the Biographic a Notice prefixed to the Aeronautical Society's reprint of the letters on *Aerial Navigation*, (Aeronautical Classics, No. 1, 1910), and to Mrs. Thompson, Cayley's grand-daughter, for personal details. For Cayley's work on mechanical flight see Ch. XV. See also 'Some Notes on Sir George Cayley as a Pioneer of Aeronautics' by the present writer, in *Aeronaut. Journal*, vol. 27, 1923, p. 371, and (with additions) in *Transactions of the Newcomen Society*, vol. 3, 1924.

Born Dec. 27, 1773.

Cayley was born at his ancestral home at Brompton in the North Riding of Yorkshire on December 27, 1773. His inclination towards scientific pursuits became apparent in early youth, and it is said that his interest in aerial navigation—'a noble art' as he subsequently termed it—was inspired when he was not more than about ten or twelve years old, by the Montgolfiers' discovery of the balloon. As he himself relates, his first experiment in aeronautics was made with a Chinese 'flying top' in the year 1796, from which time he continued intermittently throughout his life to devote a large measure of his time and thought to aeronautical problems. Cayley's first published contributions on 'Aerial Navigation' (mechanical flight) appeared in Nicholson's *Journal of Philosophy* in 1809–10, but it is with his ideas on navigable balloons as expounded during 1816–17 in the pages of Tilloch's *Philosophical Magazine* (wherein he first suggested the formation of a 'Society for Promoting Aerial Navigation'), and in the *Mechanics' Magazine* in 1837, that the present chapter is concerned. Further contributions to the latter periodical in 1843 (suggested by the discussion on Henson's 'Aerial Carriage'), and again in 1852 on 'Governable Parachutes' or 'gliders' complete the record of his extant writings. But his interest in aeronautics remained keen as late as 1854, in which year he sent to Dupuis-Delcourt a description of an improved Chinese aerial top.

His Aeronautical Writings, 1809–43.

Of his life and work apart from aeronautics and engineering little is known. In 1795 he married Sarah Walker (the only daughter of the Rev. George Walker, F.R.S.), by whom he had a large family, the members of which he took in later years for extended tours to France and Italy. The estates of his family—he was the sixth baronet since the creation of the title in 1661—in Yorkshire and Norfolk, doubtless afforded him ample occupation, and his interests as an engineer were at one time actively engaged in an extensive drainage scheme. But his chief concerns were clearly science and engineering in general, and aeronautics in particular. He conducted at Brompton a large number of experiments on the application of electricity as a motive power, and on gas-engines. in both cases (as there is reason to believe) in the hope that they might be turned to account in aerial navigation.[1] Later in life he

[1] See Nicholson's *Journal*, vol. xviii, p. 260, 1807, for Cayley's 'Description of an Engine for affording Mechanical Power from air expanded by heat'. It was 'made on a considerable scale at Newcastle', but proved unsuccessful.

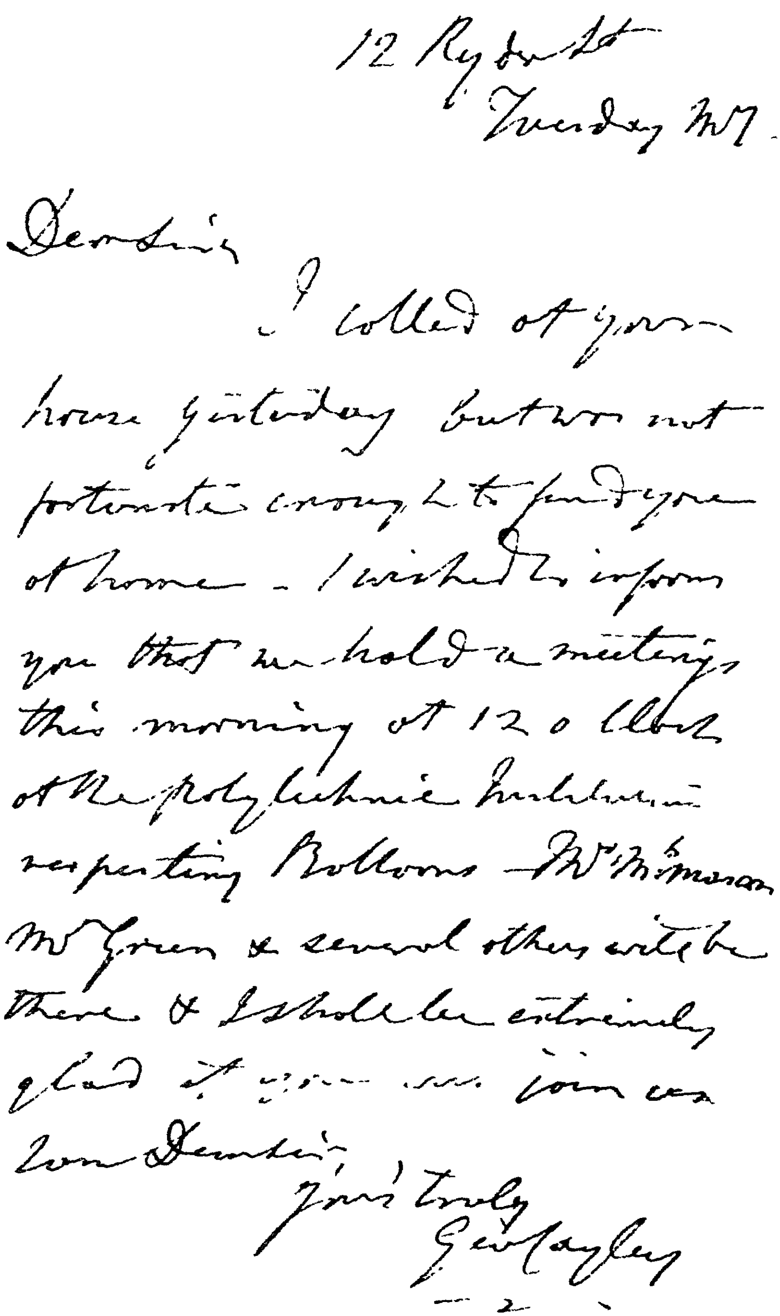
accepted the congenial office of Chairman of the old Polytechnic Institution, while in 1852 he stood successfully as Parliamentary candidate for the borough of Scarborough. But though in earlier years a prominent Whig, and keenly interested in county politics, the responsibilities and duties of a member of Parliament can hardly have proved congenial at his advanced age. Indeed, it has been suggested that he only entered Parliament in order to draw public attention to a subject which, rightly and with remarkable foresight, he realized to be of the greatest importance to mankind. He expressed complete confidence as early as 1809, in the practicability and security of 'Aerial Navigation' (this was the term he usually employed) as a method of transport, and the imaginative breadth of his conception of air travel cannot be more forcibly expressed than in his own words—'an uninterrupted navigable ocean, that comes to the threshold of every man's door, ought not to be neglected as a source of human gratification and advantage'. He is not known, however, indeed he is not likely, to have found opportunities of impressing his views on the House. In any case he retired after two years, and died at Brompton Hall, on December 15, 1857.

M. P. for Scarborough, 1852–4

His Death, Dec. 15, 1857.

Cayley's Faith in Airships.

Though Cayley's earliest aeronautical experiments and ideas appear to have been in the direction of mechanical flight, his ultimate faith in the success of aerial navigation over the world's surface, was based on the possibilities of the navigable balloon. He made this clear beyond dispute in one of his last letters on the subject. Because it had been proved on 'tolerably well-ascertained data', that elongated balloons of a large size were capable of being driven through calm air at a speed approaching that of the railway train, and could carry a considerable cargo by reason of their buoyancy, he argued that 'on a great scale, balloon floatage offers the most ready, efficient, and safe means of aerial navigation'. 'Elongated balloons of large dimensions', he wrote in the same paper, 'thus offer greater facilities for transporting men and goods through the air, than mechanical means alone . . . and when the invention is realized, it will abundantly supply the increasing locomotive wants of mankind'. Moreover, in the sentence immediately following he gave prophetic utterance to the view accepted during the last few years by distinguished aeronautical experts, as to the relation, complementary and not competitive, between airships and aeroplanes. 'Mechanical flight', Cayley wrote with remarkable prescience in 1843, 'seems more adapted for use on



12 Ryder St
Tuesday M7.

Dear Sir,

I called at your house yesterday but was not fortunate enough to find you at home — I wished to inform you that we hold a meeting this morning at 12 o'clock at the Polytechnic Institution respecting Balloons — Mr Mc Mason Mr Green & several others will be there & I shall be extremely glad if you can join us

Dear Sir,

Yours truly

Geo Cayley

FIG 114. FACSIMILE OF A LETTER FROM SIR GEORGE CAYLEY TO ROBERT HOLLOND.

a much smaller scale, and for less remote distances; serving, perhaps, the same purpose that a boat does to a ship, each being essential to the other.'[1]

His Appreciation of First Principles.

Broadly speaking, it was Cayley's ability to grasp the basic scientific principles underlying the theory of navigable balloons, rather than his skill as an inventor or designer, wherein lies his true greatness as a pioneer of the airship.[2] Ready to appreciate the suggestions of other investigators he was modest in pressing his own ideas of design, and indeed he disavowed any desire to 'scramble' for a share of such credit as was too often mistakenly attached to balloon inventions—'save only', he significantly adds, 'that of braving the risible muscles of my friends by substituting *acres* for *yards* of cloth in their structure'. For Cayley was one of the first to realize fully the practical importance of one of the main factors on which airship theory rests—namely that 'the surfaces (and hence the resistance) increase as the *squares* of the diameter of the balloon; whereas the capacity to contain gas (and hence the supporting power) increases as the *cubes* of the diameter'. If it were not for that principle he knew quite well that the 'case of steering balloons would be hopeless'. On the other hand he did not overlook, in this connexion, the great expense (an objection which led him, on hearing of Pauly and Egg's scheme, to advocate experiments by means of public subscriptions) involved in the construction and inflation of such immense balloons as his calculations showed to be necessary, nor the difficulty of handling them in high winds, and of sheltering them when not in use.

As to the principles involved in the resistance offered to a navigable balloon, he pointed out (as others had done before) that obviously the spherical form of the ordinary balloon should be lengthened horizontally, thus diminishing the cross-section, and with more originality he realized the necessity of dividing the gas into several compartments—as he said, 'like the stomach of a leech'. For a first experiment of this kind he suggested that Green's large balloon—presumably the 'Nassau'—should be

[1] *Mechanics' Magazine*, vol. xxxviii, Apr. 8, 1843, p. 276.

[2] Cayley's chief contributions to the science of dirigible balloons (on which the following remarks are based) appeared in Tilloch's *Philosophical Mag.*, vol xlvii, 1816, pp. 81 and 321 (on 'Aerial Navigation'), and again in a further paper in vol. l, 1817, p 27. These important papers have never been reprinted—hence they are usually ignored. He restated his ideas in a more lengthy communication to the *Mechanics' Mag.*, vol. xxvi, 1837, pp 418–28 (reprinted in *Aeronautics*, vols. ii and iii, 1909–10).

requisitioned, and that two other balloons should be ‘packed at opposite sides of this large one’—a suggestion, however, which was not tried. Of greater interest is the early anticipation of a rigid structure, revealed in his proposal to guard against the then unknown laws of resistance offered by fluids to solid bodies, by ‘light poles and internal cross-bracings of wire or cord’, designed to preserve the shape of the ‘prow’ of his spheroidal balloon, this being probably the earliest suggestion of the kind. Moreover, Cayley carefully entered into the problems affecting the transmission of power from an engine suspended in a car beneath the balloon to the balloon itself—a point of particular moment in his own design, owing to the need for keeping the steam-engine as far as possible below the gas-containing envelope.

His Designs for Navigable Balloons.

For the details of Cayley's own designs for navigable balloons the reader must be referred to the writings before mentioned. But a few of his ideas and the calculations embodied in his designs may be briefly stated. In his first design—the account of which was accompanied by plans (Fig. 115)—the ‘Montgolfière’ balloon was to be 300 feet long, 45 feet in elevation, and 90 feet wide, with a steam-engine capable of driving it, when manned by a crew of seven, at fifteen miles per hour. In form it was an elongated spheroid, with a conical head and a slight tapering towards the stern, on the axiom common among sailors that a ship to sail well should have a ‘cod's head and a mackerel's tail’. But in the subsequent paper, realizing the advantages theoretically apparent in a larger machine, he conceived a balloon 432 feet long, requiring 11,880 square yards of cloth (that used in his experiments weighed $\frac{1}{2}$ lb. per square foot), with a lift of 163,000 lb. Deducting 1,700 lb. for materials of construction, &c., and a further 15,210 lb. for the engine, boiler, fuel, &c., he arrived at a ‘useful load’ of 34 tons, which converted into terms of performance would mean the conveyance of 500 men for a period of one hour, or 50 men for 48 hours, the limit of a voyage in calm air being 960 miles.[1] As to propulsion he showed some preference for what he termed ‘wing floatage’ as against ‘rotative wafts’ or propellers—a method which had been proposed by John Evans (Fig. 116). Cayley also adopted with modifications the suggestion made by R. L. Edgeworth in 1795, as to

[1] These and all other figures are as given by Cayley. Cf. Southern (J.), *Treatise upon Aerostatic Machines*, 1785 (p 34), where the author calculates that the ‘distensive force of an inflammable air balloon of 100 feet diameter appears . . . to be about 44 tons’

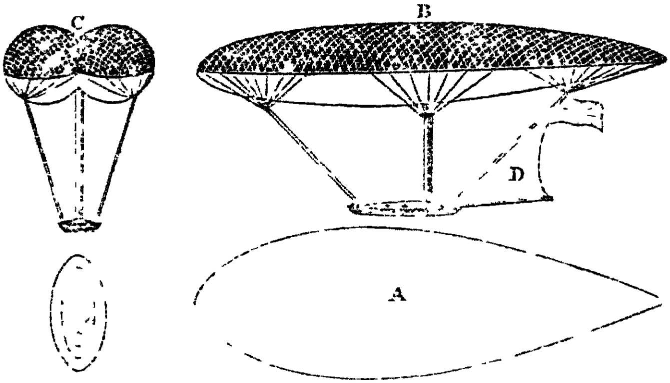


Fig. 115 Cayley's First Design for a Navigable Balloon 1816-17
On Montgolfier's Hot-air Principle 300 feet long

Fig 1 Fig 2

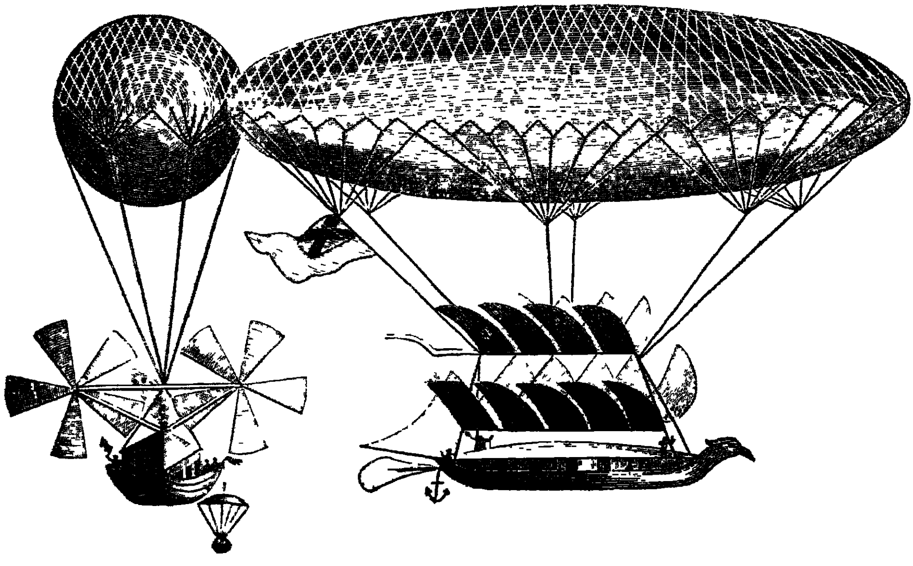


Fig. 116 Cayley's Improved Design for a Navigable Balloon, 1837
Inflated with Hydrogen, with Steam-driven Propellers

the use of a large oblique surface or ' plane ' attached to a ' Montgolfière ' balloon, in order to obtain some propelling power from the pressure on such surface during the rise or fall of the balloon. But though a plan embodying this idea appeared in the *Mechanics' Magazine* in March 1837 as ' Cayley's Navigable Balloon ', it is one of his least suggestive designs. In the same paper, however, he entered upon a full consideration, as far as the scientific knowledge of the day and the data of limited model experiments allowed, of many factors of engine power, speed, pressures, and fabric, supported by calculations which, if not always accurate, were a very notable advance on anything heretofore attempted in this country, and probably abroad.

Cayley also pointed out that the fact that previous experiments had been allowed to lapse retarded the advance of the science during the previous years. As he truly said, the results of earlier experiments (in so far as they had been published) lay, unconnected and forgotten, in the pages of the periodicals of the day, with the result that every new investigator had to take up the subject afresh. It cannot be doubted that he himself carried out numerous experiments in aeronautics—he actually mentions the weight of the fabric used in experiments bearing on navigable balloons ; he is known to have made trials with gliders, and certainly (as already mentioned) he conducted investigations relating to possible sources of motive power.[1] It is because he strove not only to arrive at reliable scientific data but also to make such knowledge available, and because his mechanical ability, touched with imaginative foresight, enabled him to realize the basic principles underlying the construction of navigable balloons, that he must be allowed a high place as a pioneer in the scientific development of the airship.

R. L. Edgeworth (1744–1817).

Contemporary with Cayley was Richard Lovell Edgeworth, who, better known as an author, is less important in the present connexion.[2] His interest in aeronautics, if not so extensive, dates back to earlier days, for he claimed to have made experiments with small fire-balloons in 1786. In June 1795 he laid his proposal to use a ' plane ' surface—such as might be formed by cloth stretched between rods—before the Royal Irish Academy, and he subse-

[1] On this aspect of Cayley's work the late Professor Raleigh's necessarily brief notice (*War in the Air*, vol. i, 1922, p. 42) is misleading.

[2] See *D. N. B.*, 1888, vol. xvi, p. 383

quently conducted an experiment of the kind in Dublin.[1] As related elsewhere (Chapter XIII) his plan was communicated to Montgolfier, and when some twenty years later it was revived by John Evans in Tilloch's *Philosophical Magazine*, Edgeworth in an 'Essay on Aerostation' (contributed to the same publication) set forth his prior claim to the invention.[2] But though the idea was taken up by Cayley it was of little practical value in aerostatic science, despite attempts ineffectually made to use it in later projects.[3] It must, however, be put to Edgeworth's credit that he was one of the few to respond to Cayley's suggestion in 1817 as to the formation of an Aeronautical Society, which he did in the practical form of subscribing the sum of fifty pounds.

Pauly and Egg's Dolphin Balloon, 1816–1817.

Probably the first serious attempt to construct a dirigible balloon in England was that made by Samuel John Pauly and Durs Egg in 1816–17. Pauly, a Swiss engineer, had followed up the idea of Baron Scott, a French officer, who in 1789 published an account of a design for a 'fish-formed' balloon fitted with fins.[4] It was from the principle of the resistance which a body experiences when rapidly striking the air, that Scott sought by actuating these fins (or wings) to obtain the means of direction, and Pauly's designs was on similar lines. His first experimental ascent was made at Sceaux near Paris, when it is said some success at direction was achieved, though a second attempt a year later at Sablons was less fortunate.[5] Pauly subsequently came to London and induced Durs Egg, also a Swiss by birth and at that time gun-maker to George III, to afford him financial assistance. A wooden shed 100 feet long, with doors from top to bottom, was built at Knightsbridge, and in it the construction of the 'Dolphin, or Fish Formed Balloon', was commenced in 1816. Its length was 85 or 90 feet,

[1] See *Trans. of the Royal Irish Academy*, vol. vi, p. 101. Edgeworth contributed an 'Essay on the Resistance of the Air' to the *Philosophical Trans.*, 1783, vol. lxxiii. His most interesting achievement as an inventor was the telegraph, minor ones being a sailing carriage and a kind of velocipede. See also, p. 320 *post.*

[2] Cf. Tilloch's *Philosophical Mag.*, 1815, vol. xlvi, p. 321; 1816, vol. xlvii, pp. 185 and 429.

[3] The principle was revived on an enlarged scale in the patent (no. 3283) granted to W. Clark in 1865. See Brewer and Alexander, p. 35. A notable application of the method was that proposed in 1850 by E. Pétin for his vast 'locomotive aérostatique'. (Lecornu, p. 172.)

[4] Scott (Baron), *Aérostat dirigeable à Volanté*, Paris, 1789. Three vignettes of his balloon are reproduced by Grand-Carteret, p. 69.

[5] See Robertson (E.-G.), *La Minerve, Vaisseau Aérien*, Vienne, 1804, Réimprimé à Paris, 1820, pp. 23–9, &c. It is there stated that the financial assistance which Pauly received from Marshal Ney was the first example of a wealthy patron of aerostation subscribing 50,000 francs to advance the science.

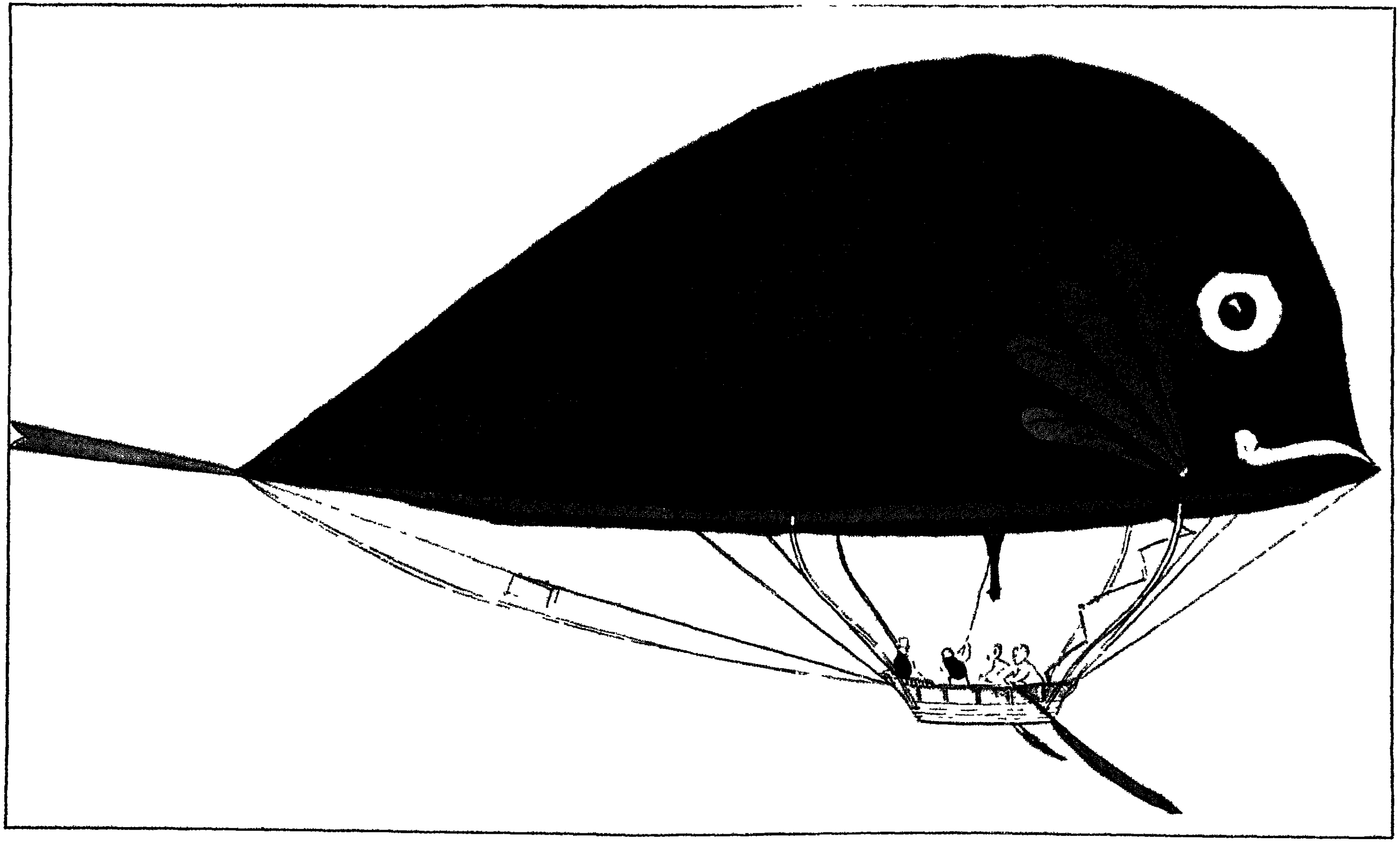


Fig 117 PAULY AND EGG'S DOLPHIN OR FISH-FORMED BALLOON
1816

its extreme height 32 feet, and its breadth 24 feet, with a rudder of whalebone and silk, 15 feet long. Within the 'fish-formed balloon' (to be inflated with hydrogen), was fitted a spherical air-balloon 21 feet in diameter—designed to 'regulate the dilation or condensation' of the gas and preserve the shape—into which air could be pumped from the car by powerful bellows worked by the feet. The main balloon was made of gold-beater's skin—the produce of 70,000 oxen—in sevenfold layers on the top and six-fold on the sides, varnished within and without. it being found necessary (in order to achieve the desired shape) to first construct the 'fish balloon' in wood and mould the envelope over it, a process which must have involved much time and money.[1]

Unlike Scott, who designed his car within the form of his 'fish balloon', Pauly suspended a punt-shaped gondola from under the balloon by means of a netting of white tape, and he sought to preserve the trim by a box of sand or water, which could be hauled aft towards the rudder—to elevate the head—or pulled down towards the car—with the opposite effect.[2] Oars of similar material to the rudder were to be plied from rowlocks, and fins were fitted to the shoulders of the 'fish'. 'The propelling impetus'—to quote the descriptive text (said to be by one who superintended the work) which was issued in 1835 with a print of the 'Dolphin'—'was a kind of atmospheric steam-engine, invented by Mr. Collier, but the great difficulty of combining power with levity occasioned much delay'.

In announcements made by the promoters they undertook to achieve 'what has never succeeded before, namely—to steer our Fish Formed Balloon at pleasure', and further, 'should the day of our ascension prove calm, we propose to shape our course in a circular direction round London'. A more guarded proviso was contained in the statement that 'if the wind should blow hard, we intend steering a different course—but not withstanding to return to the place of ascension'.[3] The project—'Egg's folly', as it was named—

[1] In a modern rigid airship of the R 33 class (1920) no fewer than 825,000 pieces of gold-beater's skin (from over three-quarters of a million oxen) were used for the gas-bags.

[2] A device of this character was used by Count Zeppelin in his first rigid airship. See Brewer and Alexander, p 1, for an abridgment of Pauly and Egg's specification (1815, no. 3909)

[3] See 'Description of the Dolphin' (Fig. 117), &c. in the Cuthbert Collection The balloon was on exhibition and subscribers at a guinea were entitled to see 'one of the ascensions'. In the Douce Collection in the Bodleian there is an engraved admission ticket to view the ascent, but it is not dated.

was subjected to inevitable gibes at the hands of wits and caricaturists. One plate published in 1818 gives a view of the airship the occupants of which are represented as replying to a hail with the words, 'We are not bound nowhere—we shall go when we can and come back when we can'. Evidently the many difficulties to be overcome led to long-drawn delays, and subsequently dissensions arose between Pauly and Egg. Finally Pauly died before the airship was completed, whereupon the project was abandoned, Durs Egg (who lived till about 1828) having borne the entire cost of the venture to the extent of £10,000. It was one of 'life's little ironies' that the only achievement to the credit of this costly, disappointing, but nevertheless interesting scheme, was the use made of the 'ballonnet' to raise the dwarf, Tom Thumb, in a diminutive car from the Surrey Zoological Gardens during an exhibition by P. T. Barnum, the American showman.[1]

Count Lennox's Aerial Ship 'Eagle', 1835.

By way of contrast to the important and scientific writings of Cayley on the theory of navigable balloons, stands the ill-devised and indeed (in more than one sense of the word) speculative construction of the so-called 'first ship the Eagle'. The promoter of this pretentious project was a French colonel of infantry, Comte de Lennox, who is said to have studied the subject for some years. He had previously been associated with Le Berrier, a doctor of Havre interested in aerial navigation, in the construction of a similar *navire aêrien*, but an attempted ascent from the Champ de Mars in August 1834 proved a complete failure. Shortly before the ascent the netting gave way, the inflated balloon escaped and burst in mid-air, while the disappointed mob below completed the destruction of the machine.[2] According to Dupuis-Delcourt—himself an aeronaut and engineer of distinction—the Count was a man of honour, whose serious endeavours in the science of aerostation and the wealth he devoted to it were misdirected by certain 'parasites incapables'. It would seem probable that these parasites were mainly responsible for the character of the undertaking in London, and that it was engaged in as a speculation. During June 1835 paragraphs appeared in the London press announcing that the

[1] See Coxwell, First Series, p. 195.

[2] See Dupuis-Delcourt, p. 138, La Landelle, p 134, and Lecornu, p. 144, and Tissandier, vol. ii, p. 37, for the Count's own description of his *premier ballon-navire*. Neither author makes any mention of the venture in London. H. André in *Les Dirigeables*, Paris, 1902 (p. 187), says the cost of the 'Aigle' was 'une centaine de mille francs'. According to M. Dollfus, Lennox was a nephew of Baron Scott, and of Scottish descent.

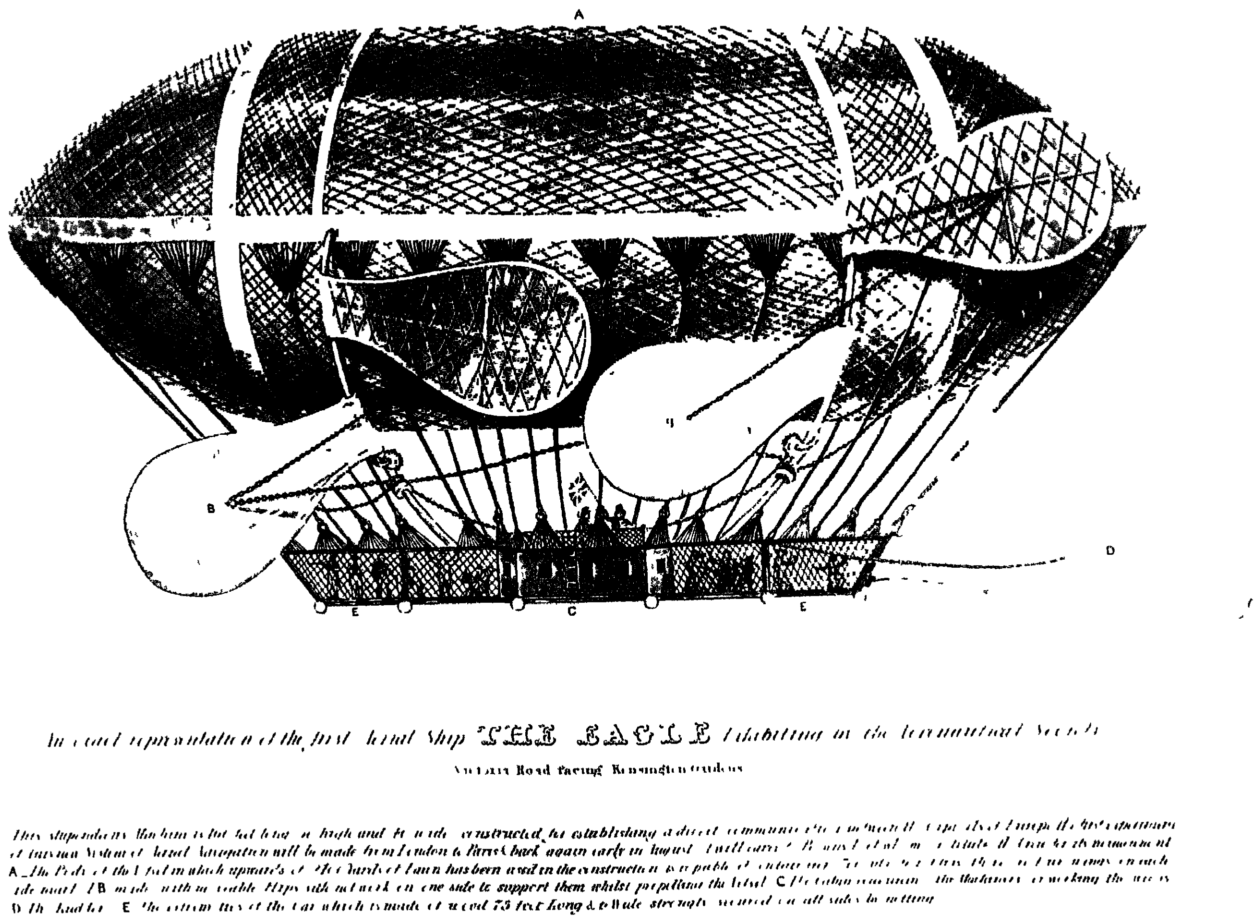


FIG 118 LENNOX'S FIRST AERIAL SHIP, 'THE EAGLE' 1835.

'European Aëronautical Society' for establishing direct communication between the capitals of Europe, proposed to exhibit the 'Eagle' in their 'dock-yard' at Kensington, and that the first experiment would 'be made from London to Paris and back again'.[1] It is, however, significant that at first there was no men-

By Authority.

A FULL AND

CORRECT DESCRIPTION

OF THIS

EXTRAORDINARY MACHINE,

THE FIRST

AERIAL SHIP,

THE EAGLE

This stupendous Machine is 160 feet long 50 high and 40 wide, constructed for establishing a direct communication between the Capitals of Europe The first experiment of this new system of Aerial Navigation will be made from London to Paris and back again early in August

LONDON
PRINTED AND PUBLISHED BY J THOMPSON,
6, GLOUCESTER STREET, LAMBETH.

1835

Fig. 119.

tion of any date, but subscribers were invited for a 'whole year' at two guineas, or for three or six months at proportionate rates.

'The Eagle' described.

The 'ship' as exhibited in London apparently differed in some respects from its original Parisian counterpart. Both were cylindrical in shape with sharply conical ends, but the car, which in the Paris ship—at least as depicted in contemporary prints—was

[1] There is in the Cuthbert Collection a small pen-and-ink sketch of this 'dock-yard', which was erected where Wilton Place now stands—'in the Victoria Road, opposite the avenue leading to Kensington Palace' (Fig. 121).

built close up under the envelope, was suspended in the machine exhibited in London some distance from the balloon, by means of ropes fastened to a canvas belt running horizontally from the centre line.[1] Moreover, oars and paddle-wheels, as originally designed for propulsion, were superseded by four movable wings

European Aeronautical Society.

FIRST AERIAL SHIP,

The Eagle,

160 feet long, 50 feet high, 40 feet wide,

MANNED BY A CREW OF 17,

Constructed for Establishing direct Communications between the several

CAPITALS OF EUROPE,

The First Experiment of this New System of

AERIAL NAVIGATION

WILL BE MADE FROM

LONDON TO PARIS AND BACK AGAIN.

May be Viewed from Six in the Morning till Dusk, in the Dock Yard of the Society, at the entrance of Kensington, Victoria Road facing Kensington Gardens, between the First Turnpike from Hyde Park Corner and the Avenue to Kensington Palace.

Admittance every Day of the Week, 1s.

Free Admission the whole Year, (Sundays and Holidays included) for Members of the Society and their Friends.

Every Yearly Subscriber becomes a Member of the Society and as such entitled not only to permanent Free Admission for himself, but also to the right of introducing at all times without any charge a Party of Friends not exceeding Eight.

Every Subscriber for Six Months, enjoys the privilege of Free Admission with Four Friends, during the whole period of his Subscription.

Subscribers for Three Months are entitled to the same personal privilege of Free Admission but with Two Friends only

Subscriptions received at the Dock Yard of the Society,

FOR THE WHOLE YEAR, TWO GUINEAS.
——— SIX MONTHS, ONE GUINEA.
———THREE MONTHS, HALF-A-GUINEA.

Mullin, Printer, 3, Circus Street, New Road, London

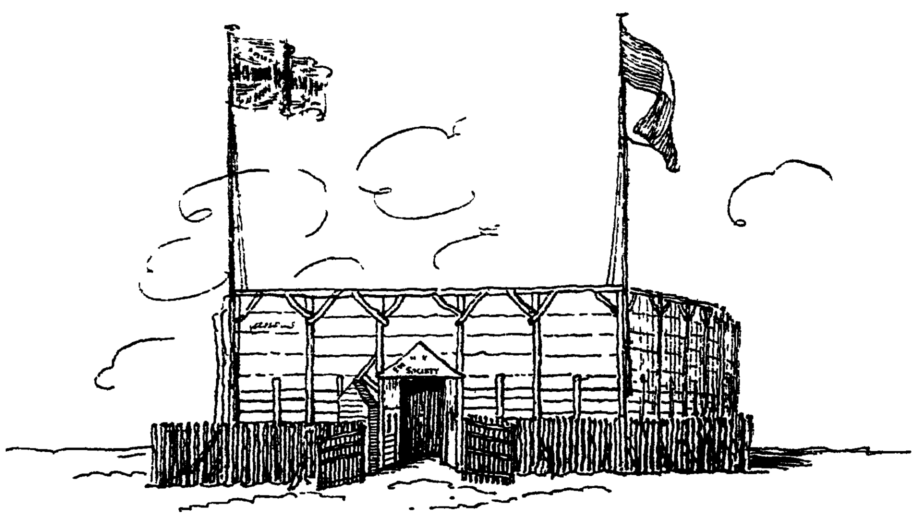
Fig. 120.

or flappers—two on each side—which were to be worked by means of chains from a central cabin forming part of the car. Presumably in both cases there was an air-ballonnet—as suggested by Meusnier and Scott—centrally placed within the envelope, and capable of being filled or exhausted 'by very simple means', while large rudders, made—like the wings—of oiled lawn stretched over a cane-

[1] It may, however, be mentioned that one contemporary writer who saw the Paris 'Eagle', reports that the London one was on an 'exactly similar' principle. Cf. the reproduction in La Vaulx, plate 57 and Fig. 118.

work frame, projected from either end. The dimensions of the London 'ship' were 160 feet long, 50 feet high, and 40 feet wide, the total weight being about 3,000 lb. The envelope was made of 2,400 yards of coarse cotton fabric, thoroughly varnished with india-rubber and covered by network. Fully inflated it was designed to contain 200,000 cubic feet of gas, giving a buoyancy of 15,000 lb. when filled with hydrogen, or 10,000 with coal-gas.

It is fair to add that Count Lennox does not appear to have entertained extravagant hopes of achievement—he clearly stated



Entrance to the Dock Yard of the European Aëronautical Society. Drawn on the Spot Aug.t 21st 1835.

Fig. 121.

his intention generally 'to go with the currents and not at all against them'. On this important point he claimed as a result of twenty years' study, and 'a course of expensive private experiments', to have learned of the existence of two currents, one usually blowing from the equator to the two poles, and the other in a contrary direction—a phenomenon of which (like Green in his Atlantic crossing) he proposed to take advantage.[1]

[1] *The Weekly Belle Assemblée*, Aug. 8, 1835, p. 144. The woodcut illustration there given is said to be the 'only correct one', all others being unauthorized. A letter in Lennox's own hand in the Patent Office Collection (vol. iv), though referring to the 'grand experiment of trying to cross the Channel', maintains that he never pretended his balloon would go against the wind. The letter (dated Aug. 19, 1835) is mainly concerned with a loan of £200 to complete the 'Eagle', which (apart from scientific considerations) he suggests is 'a very good speculation'

Exhibition at Kensington, June–Aug. 1835,

The exhibition at Kensington opened towards the end of June, and to judge from the repeated hand-bills which were printed up to the end of August, it was frequented by a large number of visitors. But save for the fact that yearly subscribers were informed they would be allowed—as far as the capacity of the 'ship' permitted—a 'free passage', nothing was said as to any ascent.

and Vauxhall Gardens, Sept. 1835.

Early in September, however, the 'Eagle' was removed from Kensington to Vauxhall Gardens, when it was stated that 'a first ascent' would be made during the month. It seems clear, however, that no attempt of any kind was made to ascend, and the exhibition finally closed in October.[1] Strangely enough, though the 'Eagle' airship was at first freely discussed in the press, was severely criticized, and then subjected to ridicule and caricature in songs and pictures, its ignominious failure raised little or no comment, Count Lennox and his 'aerial ship' thus passing with contemptuous disregard from the stage of London's aeronautical exhibitions.

MacSweeny on Directing Balloons, 1824–44.

It is reasonable to believe that the difficulty—insisted upon by Cayley—of developing the idea of dirigible balloons by reason of the great expense necessarily involved, must have proved discouraging to would-be projectors, especially when viewed in connexion with such failures as those of Pauly and Egg, or Count Lennox. Despite intermittent periods of discouragement or indifference, the subject of rendering the balloon a navigable machine continued to arouse interest, and the day passed 'when high names could stop discussion'. A typical and genuine enthusiast in the first half of the nineteenth century was Joseph MacSweeny, a doctor and scientist of Cork, whose entertaining *Essay on Aerial Navigation* was first published in 1824, a second and revised edition appearing in 1844.[2] The book deals with aeronautics at large in a 'concise', not to say abrupt style (effectually adopted in order to 'condense much matter in a small space'), and affords ample evidence of the writer's claim that he had read everything he could meet with on the subject. But,

[1] The Cuthbert Collection includes fragments of the fabric, canvas belting, and network. From pencil notes in Cuthbert's hand it appears the London 'ship' was twice the size of the Paris one, that Lennox was associated as proprietor with a Capt. Rowe and a Mr. Palmer, and that the 'Eagle' was eventually sold to Gypson, the aeronaut.

[2] Four of the chapters in the latter edition were based on papers read before the Cuvierian Society of Cork in 1837. The bibliography (at p. 83) testifies to the extent of MacSweeny's acquaintance with aeronautical literature.

as the title conveys, it is chiefly concerned with *Modes of Directing Balloons*, treated in chapters on 'The Causes of failure in attempts' hitherto made, 'Steering by the Plane', 'On Kedging', 'Trining', 'Veeing', and 'Warping' (terms invented by MacSweeny to describe his methods, and not found elsewhere), 'On Motive Power', 'Balloon Ways', and so forth.

MacSweeny's main idea as to direction was based on the conception that a fulcrum could be obtained by making use of two or three balloons connected by means of a rope or long pole, much as a ship not under way may be warped by a hawser made fast to a bollard or to a kedge-anchor. But his theoretical notions on 'alternate warping' were quite impracticable, and it is evident from his loose remarks on causing balloons to rise or descend that he had had no practical experience. In this as in other respects—notably his suggestion that falcons might be used as 'disposable' ballast, and his quaint comment that when in the air 'the birds will give little trouble if a bag be drawn over them'—he cannot be said to have strengthened his own contention that 'the labours of the studious to point out the true theory, must precede the efforts of practical men'.

For the rest MacSweeny's treatise is a farrago of history, anecdote, and theoretical speculation.[1] As to general principles, following Cayley (whose zeal and ability in the cause of aerostation he justly applauded) MacSweeny realized the significance of the fact as to the relation between the size of a balloon, its buoyancy, and resistance. He looked to the day when the 'Nassau' and other large balloons of his own day would seem to 'be only as bubbles in comparison with [those] which will probably be in use hereafter for the conveyance of passengers', and the aerostats he himself suggested for experiments in 'alternate warping' were to have seven cars with two men in each. But the calibre of his mind—his tendency to mix shrewd comment with unpractical and unsupported theorizing—is perhaps most fully revealed in the last chapter of his essay. Bearing the pregnant title, 'On the tendency of rapid intercourse between Nations to promote Peace', it unexpectedly passes into a dithyrambic appeal for international goodwill and unity, combined with an impassioned denunciation of strife and

[1] His method of historical narration (more reliable than usual as to facts) is sufficiently illustrated by his account of the accident at one of Lunardi's ascents: 'In 1786 at Newcastle-upon-Tyne, Mr. Heron had his hand in a rope; it drew him up; it broke, he was killed.' See *ante*, Ch. V, p. 137.

warfare. In the fervour of this concluding outburst the bearing of his main subject—dirigible balloons—is scarcely mentioned, though elsewhere advanced as capable of tending to 'unite the family of mankind to cause a new era, and to give a mighty impetus to the march of civilization'. The unhappy state of the land of MacSweeny's birth and the awful bloodshed of the Great War, afford so ironical a contrast with his own aspirations, that it is difficult to refrain from a final quotation. 'The balloon', he writes with quiet assurance, 'appears to be destined for a time of peace between civilized nations. Men burrow under the earth to blow up towns, construct submarine boats to destroy ships, and fight on land and water.' 'It would be too bad', he adds, in words which stand in pitiful contrast to recent developments in aerial warfare and bombing, 'that they should combat high in the air above land, after Christianity having preached peace for so many ages.'

MacSweeny's *Essay* was characteristic of a very considerable amount of theoretical writing on the subject of ballooning, which lies buried in the pages of the *Mechanics' Magazine* and elsewhere—from whence, as far as the present writer can judge, it would be unprofitable to revive it.[1] As in earlier years these theoretical schemes sprang mostly from the ingenious brains of mechanically minded men, who were by no means always engineers and who probably paid little serious attention to aerial navigation, except in so far as their own paper projects were concerned.[2] One typical inventor of a 'Plan for Steering Balloons' frankly admitted he had 'not enquired much into the subject', and did not 'pretend to understand the management of balloons'. On the other hand,

Monck Mason's Model Dirigible, 1843.

Monck Mason, though he can hardly be regarded otherwise than as an enthusiastic amateur, had had some practical experience of balloon voyages. His ideas on the 'Mechanical direction of the Balloon'—in the main sound, but set forth with an air of uncalled-for pedantry—were printed in *Aeronautica*, wherein he came to the weak conclusion that there seemed 'but little prospect of

[1] The *Mechanics' Mag.* from its commencement in 1823 to 1872, contains many communications (of varying interest and value) on aerostation and aeronautics in general. A notable paper therein (other than Cayley's) is that by J. S. Partridge, of Southwark, describing his 'Pneumodromon', or spheroidal balloon, with elaborate calculations. The latter include dimensions for dirigibles up to 280 ft. long, 1,876,582 cubit ft. capacity, and a 'floatage' of over 58 tons (vol. xxxviii, 1843, p. 396).

[2] The subject did also attract men of real mechanical ability. For instance, Mrs. Thrale, writing in 1815, records that Joseph Bramah (1748–1814)—perhaps best known for his patent lock—had invented a means of 'perfecting the guidance of an air balloon'. See Broadley (A. M.), *Dr. Johnson and Mrs. Thrale*, 1910, p. 59.

ever attaining' complete success. He deserves credit, nevertheless, for the construction of a large working model, 44 feet long, of oviform shape, with a capacity of 320 cubic feet, and weighing 20 lb. when inflated with hydrogen. It was exhibited during 1843 at the Royal Adelaide Gallery in the Strand, where by means of clock-work actuating a section of an Archimedean screw, it was propelled round the gallery at a rate of six miles per hour.[1]

C. B Mansfield (1819–1855).

Perhaps the one mind of a high scientific order applied to the problem of aerial navigation at this period was that of Charles Blachford Mansfield. Best known for his work as a chemist, Mansfield's most important contributions to that science were his discovery of the extraction of benzol from coal-tar in 1848, and his exposition of the *Theory of Salts* published in 1855. In 1850 the reading of an account of Petin's pretentious scheme embodying the use of multiple balloons—which attracted much attention at the time—led him to investigate the varied problems involved in 'aerial navigation by aid of buoyant gas'.[2] After an intensive course of reading on the subject—during which he noted that the sources of knowledge were few, inadequate, and scattered—and finding himself prevented from undertaking any adequate experimental work, he delivered his 'brain of a burden which came upon it uninvited' by writing a treatise on *Aerial Navigation: the Problem with some Hints upon its Solution.* Composed early in 1851 in the short space of a few months, it was not actually printed until 1877, which fact may account for its not having received the attention it deserved either at the time of writing or of publication. Mansfield's *Treatise* is far too comprehensive to admit of any summary, and it can only be said that the work was divided into two parts, the first being a 'Statement of the Problem', and the second comprising 'Hints for the Solution of the Problem'. In the problem considered theoretically he conceived five main difficulties, viz. the 'application of force (or propelling power), the form and rigidity of the 'gas vessell', its variable buoyancy,

His Treatise on *Aerial Navigation*, 1851.

[1] *Remarks on the Ellipsoidal Balloon propelled by the Archimedean Screw*, &c., 24 pp. [1843]. A lengthy notice based on this pamphlet appeared in the *Mechanics' Mag.*, vol. xxxix, 1843, p. 467. An engraving was also published (Fig. 122). The reported success of the model afforded E A. Poe a hint for his ingenious 'Balloon-hoax' narrative.

[2] Cf. article on Mansfield (C. B.) in the *D. N. B.*, vol. xxxvi, 1893, p. 90, where he is said to have investigated 'the whole problem of aeronautics'—a misleading statement, inasmuch as his treatise on 'Aerial Navigation' is mainly concerned with 'lighter-than-air', and only touches on winged or mechanical flight.

and its stability, these factors being treated in relation to questions of material, anchorage, and so forth. Similarly Mansfield's 'hints' are concerned with twelve main conditions—'a zodiac of requisites' as he said, the cardinal signs of which 'are the terms, Buoyancy, Shape, Level, Power: and Stability is the eclectic on which they are strung, the character that stamps them all'. Though he claimed that his conceptions 'were for the most part entirely original', Mansfield paid a tribute to Cayley as the 'one Englishman of any high scientific attainments who . . . after having carefully examined all its difficulties and facilities, had given his judgment that the navigation of the air is a possibility'. Others whose work he had clearly studied with care included MacSweeny, Monck Mason, and Marey Monge, while in general it may be allowed that the authoritative opinion on Mansfield's treatise as 'one of the most striking and suggestive works on its subject', was at the time it was written—over thirty years ago—fully justified.[1]

Bell's Locomotive Balloon, 1850.

As affording a contrast between the theoretical and the practical stands Hugh Bell's so-called 'Locomotive Balloon'—a scheme of interest if only by reason of its being the first attempt made in England to test the efficiency of the propeller as adapted to a dirigible balloon in flight. The designer, though in the medical profession, is said to have devoted considerable attention to aerial navigation. In May 1850, after numerous experiments with working models, he completed the construction of a cylindrical balloon with conical ends, about 50 feet long and 22 feet in diameter, with a capacity of 15,000 cubic feet, and capable (when inflated with coal-gas) of sustaining a load of between 500 and 600 lb.[2] It was made of white silk (expressly manufactured for the purpose) and was covered—in place of the usual rope netting—with bands of stout silk running longitudinally, transversely, and diagonally across the envelope. The car, constructed to act in case of need as a canoe, was made of light wood-work, and (as designed) was suspended by means of a framework, though in the experimental machine as tried this semi-rigid method of suspension gave place to ropes attached to the silk bands. It was proposed to fit two

[1] *D. N. B.*, vol. xxxvi, 1893, p. 90.

[2] Fig. 123. Bell took out a patent for his invention in June 1849. See Brewer and Alexander, p. 6 (1848, no. 12337). This earlier specification also provided for a mechanically propelled flying machine.

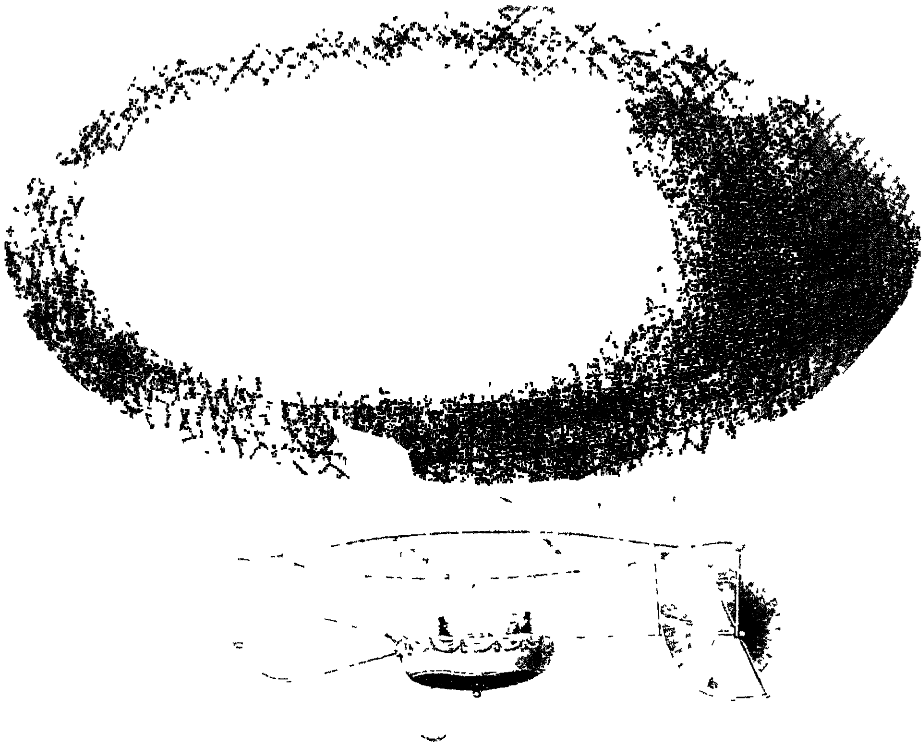


Fig 122 MONCK MASON'S MODEL AERIAL MACHINE, 1843

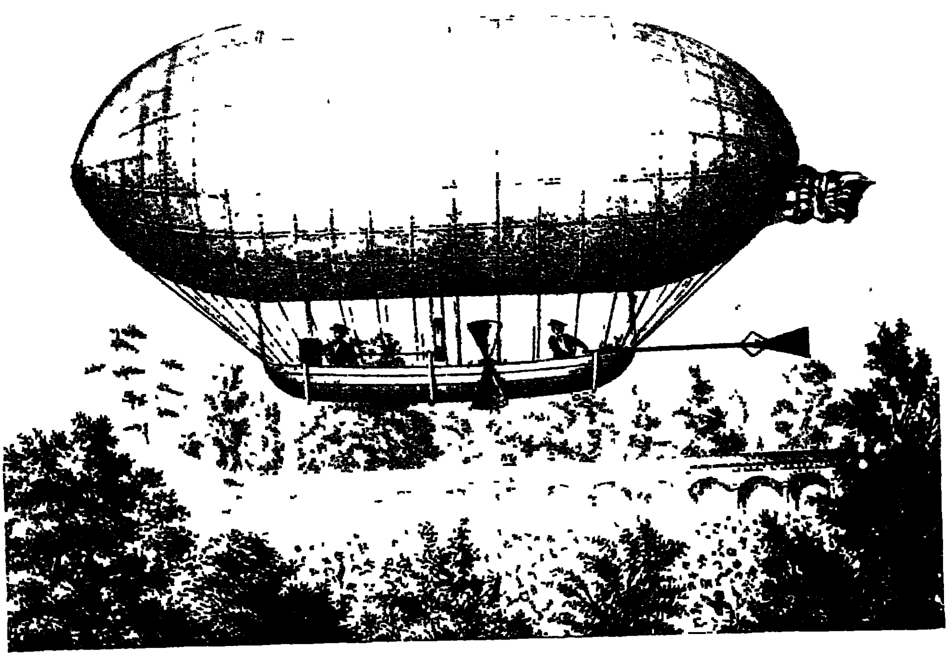


Fig 123 BELL'S PATENT LOCOMOTIVE BALLOON, 1850.

screw propellers, one on either side, but the trial was made with one only, while a fin or rudder extended from the stern was so hinged as to be capable of lateral or diagonal motion.[1]

First Trial, May 1850.

The first trial—a private affair—was made from the Phoenix Gas Works at Kennington Oval, and with Bell alone in the car the actual ascent was successful. Owing, however, to the fact that the full inflation of the envelope necessitated attention to the valve—fitted with a spring 'on an entirely new principle'—it is said that Bell was not able to observe accurately the effect of the six-foot propeller, which he himself had to work. Having drifted nearly thirty miles in about an hour and a half, he made an easy landing near High Laver in Essex, though in doing so a lad who ran to assist was struck by the grapnel, and died a few hours later. Despite the evident fact that this trial afforded no test of the screw propeller—on the efficiency of which depended the success of this 'Locomotive Balloon'—*The Times* reported with undue optimism that Bell had 'achieved a new discovery in the Science of Aerostation—that of controlling, directing, or steering a balloon'. Doubtless this laudatory notice led the proprietor of Vauxhall Gardens to induce the inventor to give a public exhibition of his 'Patent Aerial Machine'. The trial took place on July 22nd, but Bell himself subsequently admitted that as far as the motive power was concerned, the exhibition was a failure. This result he indirectly attributed to the impurity of the gas, which deprived the balloon of so much lift that the inventor again had to ascend alone, and was thus deprived of the assistance of Captain Dryden in working the screws.[2] But the plausible contention he subsequently offered—namely that it was more than one pair of hands and eyes could do to work the screw, attend to the valve, and steer, 'all at the same time!'—does not conceal the futility of his efforts at propulsion. To observers of the ascent, though the balloon was seen to float on an even keel, no apparent control was visible—the aeronaut 'twirled his

Public Trial at Vauxhall, July 1850.

[1] Bell's use of the screw called forth a protest from J. J. O. Taylor (who was a partner with Edward Shorter, the inventor in 1802 of 'Screw propellers' as applied to marine engineering), in which he drew Bell's attention to his own claim to have first suggested the use of the screw for aeronautical purposes (see *Times*, Apr. 24, 1840, and prints, &c., in the Cuthbert Collection).

[2] Capt. Dryden was interested in scientific aerostation, and had been employed at the Admiralty 'with the messenger balloons to be used in the search after Sir John Franklin'. In the Naval Museum at Greenwich Hospital there is a small silk balloon (invented by G. Sheppard, C.E.) used for carrying messages (dropped automatically) in the Franklin Relief Expedition of 1852–3.

wheels and flapped his tail', but the machine 'proceeded most pertinaciously in its original direction, and shortly disappeared'. It has only to be added that its disappearance on this occasion was final.

The projects and inventions described in this chapter represent but a small proportion of the many schemes, covering an extraordinary range of ingenuity, which the first half of the nineteenth century brought forth. Many of them were fantastic and impossible, some though rational were impracticable, all were at the time fruitless. The greater number never got farther than their fleeting appearance as designs in print, but they must stand for the expenditure of an immense amount of thought and time, and doubtless no inconsiderable amount of money. The same may be said of the endeavours of the latter half of the century, though inasmuch as at least the more serious inventions from 1855 onwards are described in the Patent Office Abridgments of Specifications (Class 4, Aeronautics), it is not necessary to deal with them at length.[1] A few diverse examples must suffice by way of illustrating the lack of any clearly defined aims—the result of wholly inadequate experimentation and research—which continued in England to be a marked feature in the evolution of the airship even at this late period.

Nye's Rocket Balloon, 1852.

A typically extravagant and unscientific project was described in *Thoughts on Aerial Travelling and on the best Means of Propelling Balloons*, by James Nye, the author (as the title states) of a shorthand dictionary, but parading in this pamphlet as the inventor of the 'Rocket Balloon'. His main idea was based on the use of an elongated balloon, 337 feet in length, to be propelled by the power obtained from the successive firing of three-pounder rockets—the old idea of aeolipyle propulsion revived on an undreamed-of scale. When it is added that Nye proposed to revive the Montgolfière method of inflation—he imagined that 'the rich stores of modern science will speedily furnish a plan far more excellent and effectual than that of burning chopped straw or vine twigs on a brasier'—enough has been said. Indeed, the minds of many readers would be overwhelmed by the mere thought of 'so laborious a calculation' as is here set forth, in respect of the number of rockets—one every seven seconds—requisite to drive this vast airship a distance of 200 miles in ten hours! Certainly the best feature of Nye's 'Rocket Balloon' was its shape, though it is at

[1] A useful selection of those specifications is given in Brewer and Alexander.

least probable that he copied it from Pierre Jullien's contemporary design for the model dirigible 'Le Précurseur'.[1]

Luntley's Rotary Balloon, 1851.

In the same category may be classed the 'Rotary Balloon', described by John Luntley (who acknowledged some indebtedness to Cayley) in his pamphlet on *Air Navigation*, 1851. The principle of construction provided for a balloon 120 feet long, the ends shaped to act as a screw. The rotation of the entire balloon was to be achieved by a band passing round its centre, the rotary movement thus serving the double purpose of traction and propulsion. Stated in these brief terms the idea sounds simple enough, but a moment's reflection on the notion of a huge elongated balloon with a twisted nose and stern, screwing its way through the heavens—let alone the means of rotating it—at once reveals an absurdity. It is true, as Luntley admitted in a paper read during 1868 before the Aeronautical Society (of which he was a member), that he soon gave up as impracticable the idea 'of making the balloon its own propeller', and he subsequently designed a spheroidal aerostat with a screw propeller at each end.[2] The most interesting point in Luntley's original design—'the strangest vagary', as Mansfield termed it, 'into which the human inventive faculty has strayed since it first went spinning with the balloon'—was the proposal to employ the hydrogen gas as fuel, by means of which device (combined with others) he estimated his balloon would travel 700 miles at 30 miles per hour without stopping, and would carry a cargo of 23 tons.

The Earl of Aldborough's Patents, 1854–7.

It remains only to add a few examples of designs embodying more scientifically calculated but still impracticable features. Coming doubtfully within this category are the very lengthy but vague specifications—accompanied by numerous drawings—prepared during 1854–7 by B. O'Neale Stratford, Earl of Aldborough, for patent purposes. As the noble Lord's ideas are set out on some 200 pages, it is impossible to summarize them beyond saying that the aerostat was of elongated form (stiffened where necessary

[1] Nye's pamphlet contains a figure of the balloon as a frontispiece. Cf. La Vaux, no. 50.

[2] *Aeronaut. Soc. Report*, 1868, p. 49. Luntley also published (anonymously) *Aerial Navigation . containing a Description of a Proposed Flying Machine on a New Principle* [with wings to be actuated by a gas-engine], 1847. But he subsequently devoted many years to the subject of navigable balloons. Writing to Major B. Baden-Powell in 1894, Luntley (then seventy-four years of age) expressed the fear 'that the present craze for flying may hinder efforts in the more hopeful direction of Navigable Balloons'.

with canes) to be inflated with heated air, and propelled by elaborate wings.[1]

Haenlein's Navigable Balloon, 1865.

A design which embodied features more directly in the line of evolution, and one which marked a scientific advance, was revealed in the navigable balloon of Paul Haenlein (1835–1905), which may be mentioned here inasmuch as the inventor took out a provisional patent in England (1865, no. 930) and was an early member of the Aeronautical Society, though (on the other hand) his foreign connexion is revealed in the more notable fact that he was the constructor (about 1870) of the first German dirigible propelled by a gas-engine.[2] Haenlein's patent covered an elongated balloon, with horizontal framework below the centre, and fitted at the nose (or bow) with a tractor air-screw driven by a gas-engine, the fuel being drawn direct from the balloon, within which was placed a compensating air ballonet.

Boyman's Metallic Balloon, 1866.

Conceived with greater originality and daring is the scheme of Richard Boyman as set forth in his patent designs of 1866, which though wholly impracticable nevertheless deserve (according to a high authority) careful study by those interested in the science of aeronautics.[3] The proposal involved nothing less than the construction of a steel balloon—cylindrical with conical ends—a quarter of a mile in length and weighing in all 600 tons. As the resistance offered by this vast mass was calculated to be only 7,070 lb., requiring a propelling force of not much over 400 horse-power, the inventor proposed to employ jet-propulsion as the motive power. Such a stupendous project can only be regarded as imaginatively prophetic (in an exaggerated sense) of the immense size which airships are destined to attain. Contrariwise there were other schemes of the time which were merely retrogressive revivals. In 1870, for instance,

Brannon's 'Arcustat' air-ship, 1871.

Philip Brannon proposed a balloon constructed in three divisions, the upper one inflated with hydrogen and the middle one fitted with a heating apparatus for rarefying the air—a dangerous idea which

[1] Brewer and Alexander, pp. 10, 12, 14 (where it is said the details of specification are quite unintelligible), 15, and 18.

[2] *I. L. A.*, p. 500, &c. See also Moedebeck, p. 326.

[3] Brewer and Alexander, pp. 37, 40, and 52. The specification (no. 3262) is prefaced with a lengthy discussion on the current state of aeronautical science. Other patents taken out for metal balloons are those of E. A. Pearce (1879, no. 2229), sheet copper with external stays, and H. J. Haddan (1887, no. 316), steel plates 'preferably 414 feet long' (op. cit.). See also J. Loose on 'Iron and Copper Balloons' in *Mechanics' Mag.*, vols. 39 and 40, 1843–4.

he omitted from the project described at length (but in vague terms) in a pamphlet entitled *The Air-Boat for Arcustatic Air-Travel*, 1871.

It only remains to add that the impression conveyed by a study of all these endeavours is that they lacked that sound scientific basis, which the data obtained from an infinite amount of careful research work and experimentation could alone supply, and which in its nature was beyond the resources of private enterprise. The many and varied problems involved in airship theory and practice were dealt with individually, but very inadequately, as they chanced to arise in the minds of inventors, and hence such knowledge and experience as may have resulted was always disconnected and soon dissipated. Questions of the best shape (or 'stream-line') with or without some rigid support; car suspension; stability and control (by movable weights, rudders, elevators, and the like); mechanical methods of propulsion; air-screws and propellers (fixed, adjustable, or with variable pitch); the production of hydrogen, even the varnish (or 'dope') for envelopes, all engaged intermittent consideration—with results that were inevitably disappointing to the inventors and of little avail in practice. But over and above all other factors—whether theoretical or experimental, aerostatic or mechanical—the wellnigh countless designs for navigable balloons or airships which the nineteenth century brought forth, were all predoomed to fail so long as the essential question of a prime mover remained unsolved. It was not until the development of the internal combustion engine afforded to airship designers the necessary motive power, in a form adaptable to the purpose, that the dirigible airship became a practical achievement. That period was not much before 1890, at which point the threads of the present work must, at some future date, be taken up by writers on the modern history of the airship—a history which will perchance reveal (in the sense of Cayley's prophetic forecast) a full measure of the utility which the airship appears destined to afford to man, as an unequalled instrument for rapid aerial transportation over vast distances of the earth's surface.[1]

[1] In the opinion of M. Chas. Dollfus a reference should have been made in the foregoing pages to Delamarne's dirigible, 'L'Espérance,' flown on several occasions from Cremorne Gardens in 1865–6. The only description of it known to the writer is by Capt. F. Burnaby, who was in it when it burst, and who regarded it as a failure. See *A Ride across the Channel*, 1882, p. 87. Delamarne was responsible for the balloon (to be inflated by the action of ammonia) which was burnt at the Crystal Palace during the Aeronautical Exhib. of 1868.

CHAPTER XIV

THE DEVELOPMENT OF THE PARACHUTE

It is clear that the idea of a parachute as an air-resisting machine dates back at least to the sixteenth century, when the universal genius of Leonardo da Vinci (1452–1519)—artist, sculptor, scientist, and mechanician—conceived the application of the device as a 'fall-breaker'.[1] In the 'Codex Atlanticus' there is a small pen-and-ink sketch of his conception, and a note on the aerodynamic factors involved, which reads (in the French translation of Ravaisson-Mollien) as follows: 'Si un homme a un pavillon de toile empesée dont chaque face a 12 brasses de large et qui soit haut de 12 brasses, il pourra se jeter de quelque grande hauteur que ce soit, sans crainte de danger.'[2]

Leonardo da Vinci's Idea of a Parachute, 1514.

Owing to the almost complete obscurity into which the manuscripts of Leonardo da Vinci passed for the next three hundred years, the many interesting mechanical ideas of which they treated remained in embryo. The idea of the parachute must be excepted, however, in so far as it was elaborated by Fausto Veranzio, whose work *Machinae Novae*, published about 1595, contains a description of a device (illustrated by a plate entitled 'Homo Volans') which was doubtless inspired by Leonardo's diminutive sketch.[3] This engraving may be accepted as the first published representation of a parachute, designed to make possible a descent from a greater height—which, as Leonardo clearly understood, involved any height—than a man could otherwise jump from in safety. Veranzio's 'flying man' is depicted descending from a tower,

Veranzio's Enlargement of it, *ca* 1595.

[1] The *O. E. D.* gives 'parachute' as derived from the French 'parer' or Italian 'parare', to ward or to shield, and 'chute', fall. The earliest quotation is from the *European Mag.*, vii, 1785, but the word was adopted from the French in 1784.

[2] *Saggio delle opere di Leonardo da Vinci* (*Codice Atlantico*), Milano, 1872. The sketch is reproduced in the paper on 'Leonardo da Vinci as a Pioneer of Aviation' by Ivor B. Hart in the *Journal of the Royal Aeronaut. Soc.*, vol. xxvi, 1923, p. 244.

[3] Veranzio (F.), *Machinae Novae*, Venetiis (*ca.* 1595), plate no. 38, and text (wrongly numbered) 39. Cf. *I. L. A.*, no. 948, where Tissandier's attribution of the date 1617 is dealt with; Bruel's reproduction of the plate, no. 179, and Boffito, p. 82, &c. Hatton Turnor also reproduced a copy of the engraving, but his note on it (p. xiii) is inaccurate.

suspended by four cords beneath an oblong and horizontal 'sail'. The French version of the descriptive text (which is given in five languages) reads thus:

'Homme volant. Avecq un voile quarré estendu avec quattre perches égalles et ayant attaché quattre cordes aux quattre coings, un homme sans danger se pourra jeter du haut d'une tour, ou de quelque autre lieu éminent: Car encore que, à l'heure, il n'aye pas de vent, l'effort de celui qui tombera apportera du vent qui retiendra la voile, de peur qu'il ne tombe violement, mais petit à petit descende; l'homme doncq se doit mesurer avec la grandeur de la voile.'

It should be added that there is no reason to believe that Veranzio, any more than other early writers on machines and devices, himself tested the efficiency of his invention, or rather his adaptation of it.[1]

During the two hundred years which followed the publication of Veranzio's design the idea of the parachute was not further developed. The circumstances of its revival towards the end of the eighteenth century are, moreover, obscure. Most writers have adopted the simple course of accepting Blanchard's words and acts as sufficient evidence that he was the inventor in the practical sense. But there is reason to believe that this view is not an adequate one, even though in a general way it may be sufficiently correct.[2]

J. Montgolfier and the Parachute, *ca.* 1779.

It is commonly known that the brothers Montgolfier invented the balloon in 1783, but it is not so generally realized that Joseph, at least, had undertaken experiments in other branches of aeronautics prior to the day when, in the manner of the oft-repeated story of Archimedes, he was able to cry aloud, 'J'ai trouvé!' During the course of early investigations into the resistance offered by the air, he appears to have experimented with a parachute, and it is recorded that he himself descended safely by means of one from a house-top at Annonay.[3] Subsequently—probably in the year 1779—he made a 'sort of parasol', 7 ft. 4 in. in diameter, and having attached to it a basket containing a sheep he let it fall from a high

[1] See Vivian, p. 19, where the common errors as to date and as to Veranzio being an architect are repeated. See also Lecornu, p. 13.

[2] Owing to the keen interest in this chapter evinced by the late Air-Commodore E. M Maitland—himself an ardent parachutist and an advocate of the view that the parachute must be regarded as a life-saving adjunct in modern aeronautics—the writer has to some extent extended it beyond the scope of this book.

[3] La Landelle, p. 64, &c. It may be remarked that Faujas de Saint-Fond makes no mention of experiments by the Montgolfiers other than those of an aerostatic character.

tower at Avignon. The object of these experiments is not known, but it is not likely that they were undertaken for testing the efficacy of the parachute merely as a 'fall-breaker'.[1] It is more probable that Montgolfier was endeavouring to ascertain the capacity of the air to sustain under pressure an extended or plane surface, and there is reason to believe that when, having invented the balloon, he sought the means to render it dirigible, he returned to the principle he had explored in his 'parachute' experiments.

R. L. Edgeworth's Parachute.

On both these points there is confirmatory evidence from an English source, which has not hitherto been noticed. In his paper on 'Aerostation', published in 1816, Richard Lovell Edgeworth relates that when he met Montgolfier in Paris in 1802 the French inventor remarked that the only practicable suggestion he had ever received as to directing balloons was contained in a letter 'from a gentleman in Ireland'. This letter was as a matter of fact written by Edgeworth to the Marquis de la Poype, who had shown it to Montgolfier, and it dealt with the idea of using a plane surface, fitted at an oblique adjustable angle, as a means of rendering the fire-balloon a dirigible machine.[2] Moreover, Edgeworth tells an anecdote of Montgolfier to the effect that having explained to the latter a method of making 'his parachute perfectly safe and equable', Montgolfier pointed to his balloon and parachute suspended from the roof of the Conservatoire des Arts, and said that the parachute should be taken down and Edgeworth's substituted in its place.[3]

Blanchard's First Use of a Parachute, *ca.* 1777.

But whatever the truth as to the part played by Montgolfier, Lenormand, or others in the revival of the invention, it must be allowed that the credit for having first tested the principle of the parachute by experiments made from a balloon belongs to Blanchard. If his own statement be accepted—and it must be added that his word is often far from unimpeachable—he first used the device in 1777, presumably when making experiments on flight, prior to the construction of his 'vaisseau-volant' during the years 1781–3.

In the absence of any definite information it can only be added

[1] It must be borne in mind that the term 'parachute' may not always have been used by different writers in early times with quite the same meaning.

[2] See MacSweeny, p. 29, where the writer states (though without quoting his authority) that 'J. Montgolfier paid much attention to the plane'.

[3] Tilloch's *Philosophical Mag.*, vol. xlvii, 1816, p. 185. See also Ch. XII, p. 301, and La Landelle, p. 63, 'Les Parachutes de Joseph' [Montgolfier].

that in a French caricature of Blanchard's 'vaisseau-volant'—which, though undated, probably appeared in 1781 or 1782—a parachute in the form of an open umbrella is depicted as fixed above the machine. Further, it may be noted that the hero of Restif de la Bretonne's 'flying' romance, *La Découverte australe*, 1781, is seen in the engravings with which the book is illustrated to be equipped with a parachute of a similar character.[1] Whether the artist's conception was merely imaginative and conceived to illustrate the author's vague descriptions of his hero's flying apparatus, or whether (as the marked similarity suggests) he got ideas from Blanchard's alleged use of a parachute in 1777, it is difficult to determine. In any case the plates are usually regarded as being the first pictorial representations—albeit of an imaginative character—of a parachute used in flight.[2]

But before describing the parachute used by Blanchard in March 1784—from which date its development can be more clearly traced—reference must be made to two other pioneers. One, a French physician, Sébastien Lenormand, ventured on a practical test of the efficacy of a parachute (14 feet in diameter, cone-shaped, and made of cloth or oil silk) by descending from the tower of the Observatory at Montpellier, creating thereby a great sensation. This occurred in December 1783—subsequent to Montgolfier's experiment, of which it is said Lenormand was ignorant.[3] The other, an Englishman, Thomas Martyn, claimed in his *Hints on Aerostatic Globes*, published in October 1784, that his theoretical design of a navigable balloon—fitted (as previously described) with sails, a rudder, and, immediately below the appendix, 'an Umbrella to afford an easy descent, should the Balloon burst'—was 'similar' to the one he had presented to the Prince of Wales in November 1783.[4]

Lenormand's Parachute Exploit, Dec. 1783.

Martyn's 'Umbrella' Parachute, Nov. 1783.

As a matter of fact, Martyn's design led to a controversy with Blanchard, when the latter visited this country in the autumn of 1784. On seeing a copy of Martyn's *Hints*, Blanchard addressed a letter to the author (through the medium of the press) with

Martyn's Controversy with Blanchard, 1784.

[1] Restif de la Bretonne, *La Découverte australe par un homme volant*, four vols., Paris, 1781.

[2] See Bruel, nos. 12 (with which cf. Grand-Carteret, p. 13) and 199 Plate 200 in the same work is of interest in this connexion as depicting the use of a species of parachute in descending from a balloon. See also Dupuis-Delcourt, p. 6.

[3] La Landelle, p. 161. Cf. Lecornu, p. 123, who gives Lenormand's own description of his parachute.

[4] See *ante*, Ch. XIII, p. 287.

special reference to the incorporation, as an original design, of the 'umbrella' or parachute, which Blanchard himself claimed to have invented as before mentioned. 'As to its being adapted to Air-Balloons,' he wrote, with undisguised scorn for his rival's obvious inexperience as a practical balloonist, 'let the discovery be yours: experience has convinced me that it can answer no manner of purpose.' In his reply Martyn was discreetly vague—he did little more than affirm that he only claimed originality for the actual application of the parachute to balloons, shrewdly adding that the obvious air-resisting propensity of an umbrella must have occurred to any one who had held that article over his head in a strong wind.[1]

Returning to Blanchard's unquestionable connexion with the parachute, the engravings of his first balloon—with which he attempted an ascent, from Paris on February 27, 1784—show that he originally fitted a parachute in the same position as Martyn had done, but found that the weight of it and of the wings and rudder which were affixed to the car were more than the balloon would lift. He therefore discarded the parachute and other gear, and five days later accomplished his first ascent from the Champ de Mars. Though later engravings of his balloon frequently depicted it as incorporating a parachute, there is no reason to believe that he ever actually used one in this way.

Blanchard's First Parachute Experiment from a Balloon.

During Blanchard's prolonged stay in England during 1784–5 he took up anew the idea of the parachute, and on June 3, 1785, made his first experiment with a silk parachute (20 feet in diameter) released from a balloon when in mid-air.[2] Thereafter he frequently repeated the experiment, usually suspending a small dog in a net-work bag or basket beneath the parachute (Fig. 124), though beyond establishing the fact that the animals descended without hurt, such experiments do not appear to have had any definite aim. Doubtless they appeared at that time to be 'astonishing, nay, miraculous to common capacities', and as such were exploited in order to impart novelty to the mere 'repetition of the dull and

[1] An early reference (of an imaginative kind) to the principle of the 'parachute' as a 'fall-breaker' occurs in Cyrano de Bergerac's *Histoire Comique des États et Empire de la Lune*, 1657, wherein an inhabitant of the Sun lands gently on the Moon's surface owing to 'the large skirts of his Gown' being swelled out by the wind. (See *The Voyages to the Moon and the Sun*, translated by R. Aldington [1923], p. 70.)

[2] See *ante*, Ch. VII. Tissandier (vol. i, p. 118) printed for the first time the certificate —signed by Pilâtre de Rozier, Sheldon, Biggin, and Argand—concerning this experiment.

hackneyed experiment of simply elevating human beings into the air by means of inflammable gas '. It is true that by 1787 Blanchard had made a large parachute big enough to sustain a ' man or a large animal '. but it is doubtful whether he ever had sufficient faith in its efficiency to undertake the risk himself, despite Monck Mason's assertion—for which he gives no authority—that Blanchard broke his leg in attempting a parachute descent.[1]

Garnerin's First Descent, Paris, Oct 22, 1797.

The honour of being the first man to descend safely from a balloon by means of a parachute is universally accorded to André-Jacques Garnerin, and it was in Paris on October 22, 1797, that his success was achieved. In the programme issued on this occasion Garnerin made the interesting statement that it was during his imprisonment at Budapest that he first conceived the idea of using (as a method of escape) the experience gained by Lenormand's parachute experiment at Montpellier.[2] Not less interesting is his reference to Blanchard's idea of ' presenting large surfaces to the air to neutralize, by its resistance, the acceleration of the falling momentum of bodies ', as one which only required working out in order to be applied with success. Of the first descent a descriptive account was subsequently published by Lalande, Garnerin himself describing his experience in the *Journal de Paris*.[3] As will be seen later Garnerin was also the first to achieve a successful parachute descent in England.

Thus far the development of the parachute had been delayed from the lack of any clearly defined aim. In its primitive inception it took the crude form of a ' machine ' consisting of fabric stretched over a rigid frame, designed to offer resistance to the air and thus allow of a gradual fall from, say, a high tower. Apparently forgotten for about two hundred years, it reappeared—with the characteristics of a silk parasol, strengthened with ribs—when used by Blanchard in 1777–81 to guard against or retard the too

[1] *Ausführliche Beschreibung der acht und zwanzigsten Luftreise, welche Herr Blanchard den 12 Nov. 1787 zu Nürnberg unternahm*, Regensburg, 1787. One of four plates in the book is of the balloon, gas plant, &c., and shows both a small and a large parachute (*Fallschirm*) of fine silken fabric. The latter (measuring 18–20 feet in length) is shown drawn together like a curtain, and was only intended for the descent of ' men or large animals '. Cf. Monck Mason's letter in *Aeronautica*, p. 231, and an article on ' Parachutes ', by T. B. O'Hubbard, in *Aeronautics*, vol. iii, 1910, p. 32.

[2] See Bruel, p. 32, where the particulars of an alleged attempt to escape are described.

[3] Dupuis-Delcourt, pp. 239–43, and Tissandier, vol. i, pp. 146–8. See also *I. L. A. Catalogue* (p. 168), in which it is said that Garnerin's first parachute was from 7 to 8 metres in circumference.

sudden fall of his flying machine, above which it was rigidly fixed like an open umbrella. In 1783 it is again used in the form of an umbrella, but with a more definite and independent purpose of its

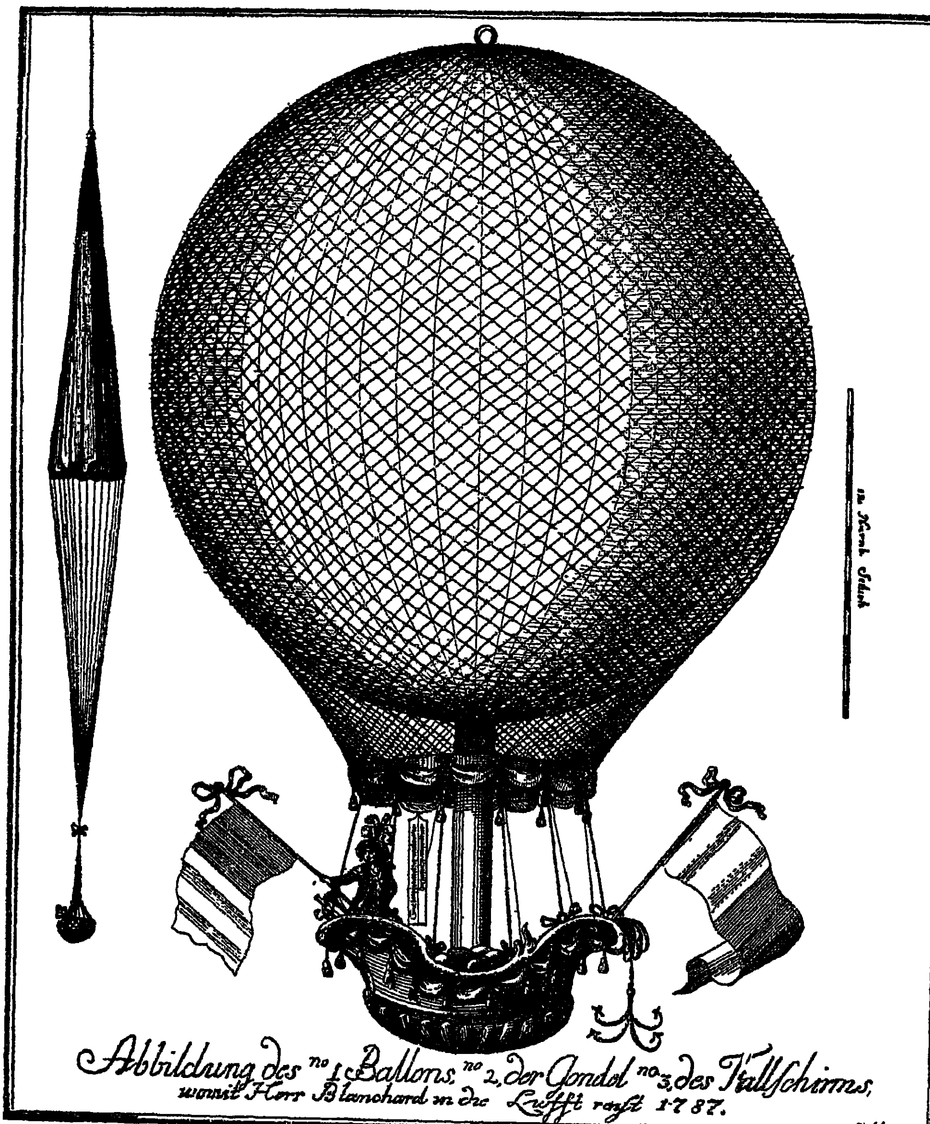


Fig. 124.

own, by Lenormand, who demonstrated from the windows of a house that it might serve as a means of escape from fire. A year later Blanchard fitted a ribbed parachute beneath the appendix of his first balloon, thus retaining as a safety device an idea which

he had originally adopted in connexion with his 'heavier-than-air' experiments. Having quickly discarded it as a useless impediment, he took to experiments with small parachutes made of silk and cords, which for the first time were dropped from his balloon in mid-air—sometimes from the car, sometimes detached from beneath the car, and sometimes released from the circumference of the balloon—and which opened out in the course of their fall. But these experiments with parachutes of such fragile material, though they allowed of the safe descent of small animals, may well have seemed inadequate to sustain the weight of a man. Moreover, the doubts which must have arisen as to making quite certain that the parachute would open, tended to prevent the full-scale tests or experiments which alone could ensure the development of the principle, applied as a specific device for ensuring a safe descent from an aeronautical machine in mid-air. That is the definite practical purpose which it had been destined to fulfil—a purpose which years ago earned for it the title of the 'life-belt of the air', though perhaps a more fitting analogy is to be found in the capacity of the life-boat to afford a safe landing.

Arnold's Parachute, 1785.

Prior to Garnerin's first descent in London very little attention, either theoretical or practical, had been paid to parachutes in England. It has been seen that an attempt was made jointly by Arnold and Appleby in August 1785, though nothing is known as to the technical construction of the parachute. From a small contemporary—but premature—engraving of the balloon as designed for the ascent, it is evident that the parachute was made with stiff ribs, suspended like an open umbrella beneath the basket of the balloon, and sustaining a small car attached by numerous cords.[1] It was to have been released at a height of about 5,000 feet, but the affair proved a complete fiasco owing to the accident previously described, though it is worthy of note that the accident afforded one of the earliest instances of the possibility of allowing a balloon to act as a parachute.[2]

Doubtless other experiments of one kind and another were attempted during this period, but few records of them remain. For instance, in 1790 a man named Murray is said to have descended safely—after the manner of Lenormand—from a church tower at Portsmouth, and to have subsequently repeated his experience from the Bell Tower at Chichester. On the latter occasion it is

[1] See Ch. VIII, p 191.

[2] See *post*, p. 338.

recorded that 'a gust of wind laid this bold aerostatic adventurer and apparatus in a horizontal position', and he fell to the ground with great force, though without a fatal result.[1] But clearly it was in a large measure the cumulative experience afforded by Blanchard's experiments both in England and subsequently on the Continent, that led the way to Garnerin's success.

Garnerin's Parachute Descent in London, Sept. 21, 1802.

As briefly recorded in a previous chapter, the first successful parachute descent from a balloon made in this country was achieved by Garnerin (this being his fifth parachute exploit) on the occasion of his ascent from the Volunteer Ground, North Audley Street, on September 21, 1802. His parachute, made of white canvas or sail-cloth, was formed by thirty-two gores into hemispherical form, measuring 23 feet in diameter—approximately the same shape as used to-day. This gave it a surface of about 860 square feet, and allowing 230 pounds for the weight supported, it was calculated that the descent would be made at the rate of about 10 feet a second, roughly equivalent to a fall from a height of 12 feet. As Garnerin had experienced in his first descent the unpleasantness, not to say danger, of oscillation, he is stated by Dupuis-Delcourt to have cut a hole in the top of the parachute (prior to his second attempt) so as to allow the compressed air some means of escape—an 'important perfectionnement' which was claimed to be effective.[2] In the parachute used in London this device was presumably rejected, as may be gathered from a contemporary description of the apparatus. At the top of the parachute 'was a truck or round piece of wood, 10 inches in diameter, with a hole in its centre [used for the rope, 'wove like a patent sash-line', which passed through a tin tube to the balloon above], fastened to the canvas by 32 short pieces of tape. At about 4½ feet from the top of the canvas, a wooden hoop about 8 feet in diameter was affixed, and secured by a string from each seam, so that when the Balloon ascended, the Parachute hung like a curtain from the hoop, and appeared cylindrical, between the Balloon and the Car', the latter being in the form of a cylindrical basket, covered with paper about four feet high and two feet and a quarter diameter.[3]

His Parachute Described.

[1] Annual Register, Mar. 19, 1790. Air-Commodore E M. Maitland informed the writer that in his opinion these alleged accounts were most unlikely to be true.

[2] All parachutes in present-day practice are fitted with an opening at the apex.

[3] *A Faithful Account of M. Garnerin's Bold Adventure in his Parachute,* with an engraving (dated Sept. 23, 1802) showing the ascent and descent. This plate was first published in the previous August, but the later impression is slightly altered, and the oscillating parachute added. See also Figs. 125 and 126.

FIG. 125 THE FIRST PARACHUTE DESCENT IN ENGLAND, SEPT 21, 1802

Made by Garnerin, from the Volunteers' Ground, Grosvenor Square

Having entrusted to the charming Mrs. Sheridan (who with her distinguished husband was present on the ground) the launching of a pilot balloon, Garnerin shortly before 6 p.m. climbed into the basket and ascended rapidly beneath the balloon. As the occasion was historic in the annals of aeronautics, Garnerin's experience may be given in his own words :

Garnerin's Narrative.

'Whilst the anxious crowd were following the path of my little pilot, I suspended my parachute to the balloon, this painful and difficult operation was executed with all possible address, by the assistance of the most distinguished personages. The parachute was gradually suspended, and the breeze which was very gentle, did not produce the least obstacle. At length I hastened to ballast my cylindrical bark, and to place myself in it ; a sight which the public contemplated with deep interest—it seemed at that moment as if every heart beat in unison, for, though I have not the advantage of speaking English, every one understands my signs. I ascertained the height of the barometer, which was at 29½ inches. I now pressed the moment of my departure and the period of fulfilling my engagements with the British public. All the cords were cut ; I rose amidst the most expressive silence, and, launching into infinite space, discovered from on high the countless multitude that sent up their sighs and prayers for my safety. My parachute in form of a dome over my head, had a majestic effect. I quickened my ascending impulse, and rose through light and thin vapours, where the cold informed me that I was entering into the upper region. I followed attentively the route I was taking and perceived that I had reached the extremity of the city, and that immense fields and meadows offered themselves for my descent. I examined my barometer, which I found fallen to 23 inches—the sky was clear, the moment favourable, and I threw down my flag to endeavour to shew to the people assembled that I was on the point of cutting the cord that suspended me between heaven and earth. I made every necessary disposition, prepared my ballast, and measured with my eye the vast space that separated me from the rest of the human race. I felt my courage confirmed by the certainty that my combinations were just. I then took out my knife and with a hand firm from a conscience void of reproach, and which had never been lifted against any one but in the field of victory, I cut the cord. My balloon rose, and I felt myself precipitated with a velocity which was checked by the sudden unfolding of my parachute. I saw that all my calculations were just, and my mind remained calm and serene. I endeavoured to modulate my gravitation, and the oscillation which I experienced increased in proportion as I approached the breeze that blows in the middle regions ; nearly ten minutes had elapsed, and I felt that the more time I took in descending the safer I should reach the ground. At length I perceived thousands of people, some on horse-back, others on foot, following me, all of whom encouraged me by their wishes, while they opened their arms to receive me. I came near the earth, and, after one

bound, I landed and quitted the parachute, without any shock or accident. The first person that came to me pressed me in his arms; but without losing any time, I employed myself in detaching the principal circle of the parachute, anxious to save the instrument that had so well guaranteed me, but a crowd soon surrounded me—laid hold of me, and carried me in triumph till an indisposition, the consequence and effect of the oscillation I had experienced, obliged the procession to stop. I was then seized with a painful vomiting, which I usually experience for several hours after a descent in a parachute. The interval of a moment, however, permitting me to get on horse-back, a numerous cavalcade approached to keep off the crowd, whose enthusiasm and transport incommoded me not a little. The Duke of York was among the horsemen, and the procession proceeded with great difficulty in the midst of the crowd, who shouted forth their applause, and had before them the tri-coloured flag which I had thrown down, and which was carried by a member of Parliament.[1] Among the prodigious concourse of persons on foot, I remarked Lord Stanhope, from whom I had received the councils of a scientific man, and who penetrated through the crowd to shake hands with me. At length, after several incidents, all produced by the universal interest with which I was honoured, I withdrew from the crowd without any other accident than that of having my right foot jammed between the horse I rode and a horseman who pressed too close to me. My Parachute was preserved as well as could be expected, a few of the cords only were cut—it is now exhibited at the Pantheon, where a great concourse of persons have been to examine it.'[2]

To the large number of spectators who witnessed the descent from neighbouring points of vantage, the outstanding feature of Garnerin's sensational descent was the violent oscillation of the basket in which Garnerin was suspended. On reaching a height variously estimated at between 4,000 and 8000 feet, he cut the cord, and the balloon thus relieved of weight instantly rose with greatly increased rapidity, and was soon lost to sight.[3] For some seconds little was visible, save an indistinct falling object. Then the parachute opened, and a safe descent was apparently assured, only to give place to what appeared to be a new danger—namely that of oscillation. This swaying of the basket beneath the parachute

[1] The presence of the Duke of York was a piquant coincidence, as Garnerin was made prisoner at Marchiennes by troops under the Duke's command (see Ch. X, p. 218).

[2] *A Faithful Account*, &c., reprinted in *The Annual Visitor* for 1803, vol. ii, p. 13–24.

[3] It was subsequently recovered, undamaged, at Frensham, near Farnham in Surrey, thirty-six miles away. In order to ensure the prompt descent of balloons used in later parachute exploits, a weight is fastened to the top which causes it to turn over when released, and thus allows the gas to escape through the neck of the balloon. See MacSweeny (J.), *Aerial Navigation*, 1844, p. 16, where this idea is attributed to Wright in 1803. Cf. also plate 74 in Lockwood Marsh.

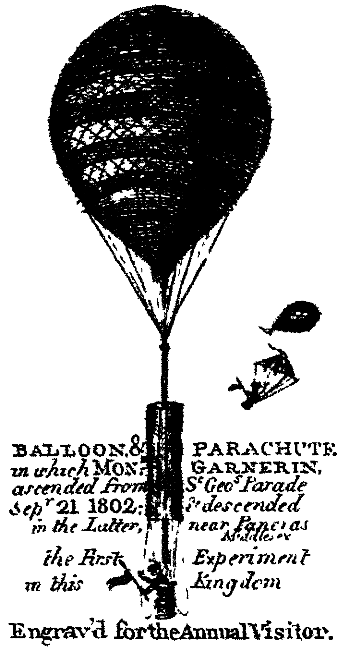


FIG 126 GARNERIN'S BALLOON AND PARACHUTE

FIG 127 ANDRÉ-JACQUES GARNERIN
The First to Descend in a Parachute from a Balloon

(which was aptly likened to the 'swing of the pendulum') commenced almost as soon as the opening was complete, grew more violent in the course of the descent, and at one time is said to have extended to nearly 45° either side of the perpendicular. The sensation created by the imminent danger of this novel and exciting spectacle was intense, and the sight of the small basket containing the daring aeronaut swaying rapidly from side to side till at times it appeared on a level with the parachute itself, produced violent emotions of horror and dismay, which found vent in the shrieks of women and was evinced in consternation among the men. This aspect of the event had indeed a tragic significance, for one of the anxious spectators was Robert Cocking—then a young man of twenty-four—who was so impressed with the danger of an oscillating parachute that he set himself to overcome it, and was fated thirty-five years later to lose his life in the attempt.[1] As the descent continued, the swaying motion diminished and Garnerin landed safely, though in an exhausted condition, in a field near St. Pancras Church.

The Oscillation of Garnerin's Parachute.

Respecting the dangerous oscillation of the descent, Garnerin himself admitted that the motion was so violent as to render him almost insensible, and though he refrained in his original account of the affair from any comment on this swinging movement, when he found the newspapers describing it in a sense derogatory to his skill, he sought to explain it. In this attempt to bridge a 'chasm' in the report—as he himself termed it—he states that the swaying was greater on this occasion than in his previous experiments in Paris. By an obviously unscientific process of reasoning he laid down that a parachute 'perfect in construction' can only descend by the 'evaporation of the air'—an expression due to the translator, but which in the original presumably meant the 'escape' of the air compressed within the dome of the parachute. As a first inclination of the weight suspended beneath the parachute (which causes this compression) may be easily set up—for instance by the wind or the posture of the parachutist—and as the resulting oscillation must continue so long as the compressing force 'excites' rapid 'evaporation', Garnerin arrived at the conclusion that the weight sustained by the parachute was a prime factor in the violent swings of the pendulum. As proof

[1] Cocking actually met Garnerin at a later date, for a signed portrait of the latter in Cocking's extra-illustrated copy of Cavallo is endorsed, 'This portrait was presented to me by M. Garnerin, 24th Sept., 1814, R. Cocking' (Fig. 127). See Appendix IV, p. 415.

of this he alleged that while at the outset he reasoned the equilibrium would be restored by throwing out some part of the 100 lb. of ballast which he took up, finding that this failed, and realizing that he must inevitably be dashed to pieces if he struck the ground in the course of one of the oscillations, he saw 'what was proper to be done'. Thereupon he immediately threw out everything in the car—even to the barometer, which (surely a little unreasonably) he complained was never restored to him—with the result that the swaying ceased in a moment, to be followed by no more serious consequences than a feeling of sickness which became intense after he landed.[1]

From this experiment—which he regarded as the most useful he had made—Garnerin inferred that 'the greater the surface of the parachute is, and the less it is loaded, the lighter the descent will be'—a conclusion sound enough, but based rather on empirical deductions than on any scientific understanding of the complex aerodynamic factors involved. Indeed, Garnerin's explanation laid him open to severe criticism, which in fact he received and which he resented as being 'silly remarks' or attacks on his reputation. One correspondent criticized the use of the word 'evaporation' as equivalent to 'escape'—an interpretation followed by the caustic comment that 'if escape and evaporation are synonymous terms, M. Garnerin might as well say, that his master Dumouriez, evaporated from the Army of Flanders', when the Convention ordered him to return home. The erroneous character of other statements—characterized as a 'tissue of absurdities'—was also exposed, and in conclusion Garnerin was dismissed with a contempt not wholly deserved, as a man 'performing for hire and making the most of his talents, like any other *marchand d'orviétan*'. Other comments also appeared in the press both before and after the event, but such interest as they retain rests mainly in the fact that they are amongst the earliest newspaper reflections on the parachute.[2]

[1] Air-Commodore E. M. Maitland told the writer that on the occasion of his descent in a parachute (from 10,500 feet) in 1915, he also suffered similar inconvenience from sickness.

[2] See cuttings in the Cuthbert Collection. One writer suggested that the 'distance between the person suspended and the Parachute [that is to say, what is now termed the 'rigging' and 'life-line'] ought to be great, in order to prevent the vibrations', while the trial of a parachute fitted with 'several divisions . . . formed with cloth in the under side . . . something like those of a lemon or orange', was recommended on the same grounds.

FIG 128. ROBERT COCKING.

Garnerin did not repeat his parachute exploit in London, and for thirty-five years no Englishman essayed to follow his example, though all that time Cocking was contemplating an improvement on it. As a matter of fact Garnerin's descent, while it gave rise to such expressions as 'sublime intrepidity' and so forth, gave rise also to strong expressions of disapproval, based for the most part on the ground that parachutes, like balloons, had been proved incapable of answering any useful purpose, and that as merely affording to the 'great and small vulgar' the sight 'of a man risking his life for a trade, they should be forbidden.[1] Indeed, as late as 1837 Monck Mason—who was then regarded as one of the first authorities on aerostation—spoke of the 'inutility of the invention'.

Robert Cocking, whose unhappy fame spread out of all proportion to the significance of his aeronautical achievements, was the son of an Irish clergyman and by profession a water-colour painter, an occupation with which he combined a taste for scientific pursuits.[2] His interest in aeronautics, or more particularly in the parachute, dates (as already mentioned) from the day on which he witnessed Garnerin's descent in 1802. In 1814 he lectured on the subject at the London Institution with so much success that (it is said) he was invited to repeat the lecture before the Society of Arts, whose medal he subsequently received.[3] He does not appear to have taken up ballooning in any practical sense, but is reported to have made an ascent with Sadler at Bristol, and in later years he went up with Charles Green on more than one occasion. For years he must have been engaged in working out his parachute theory, one of his earliest unfruitful designs embodying a modification of the so-called Garnerin type, the oscillation of which he conceived at one time might be overcome by some method of adjustable weights made to slide on rods.

Robert Cocking (1777–1837).

Curiously enough the umbrella is definitely associated with this page in the history of parachutes, for Cocking is said to have derived the first idea of his 'inverted cone' parachute, from

His 'Inverted Cone' Parachute.

[1] Sir Sidney Smith went expressly to see Garnerin after the descent on purpose, as he said, 'to shake hands with a brave man'.

[2] An original wash drawing by Cocking of Sadler's ascent from Burlington House, is comprised in the important collection of aeronautical prints formed by Sir David Salomons, Bart.

[3] The Society of Arts have no record of the lecture or the award of the medal. Amongst other mechanical models made by Cocking was one of a tea garden, with a balloon which could be made to ascend. He is known to have had a 'numerous collection of books and prints relating to aerostation', which was subsequently acquired by Robert Hollond. (See Appendix IV.)

observing that a parasol which accidently fell handle downwards from a balcony, swayed backwards and forwards, but that on turning over it fell with the stick uppermost in a perpendicular line. It is not improbable, however, that Cocking obtained the idea of his 'inverted' parachute from an article by Sir George Cayley on 'Aerial Navigation', which appeared in February 1810.[1] In some preliminary remarks on parachutes Cayley expressed the opinion that the type used by Garnerin was 'nearly the worst possible', and he agreed that on scientific grounds a parachute with an 'inverted' surface would be preferable. In proof of his statement that 'the apex downward is the chief basis of stability in aerial navigation', he suggested an experiment with a circular piece of paper, folded across and weighted in the centre, which dropped weight downwards would make a perpendicular fall, but with the weight uppermost would promptly turn over and fall apex downwards—a minor experiment analogous to Cocking's alleged experience with the umbrella. But whatever the origin, Cocking now sought to work out a design of this 'inverted cone' type, which—given sufficient size—would offer adequate resistance to the air, his idea being that the atmospheric pressure during the descent would be equal all round, and would thus ensure a steady but retarded fall.

Having made models of his design, Cocking subsequently tested them from the top of the Monument at London Bridge and on Hampstead Heath—the latter tests being made by means of a small hydrogen balloon—in competition with a model of Garnerin's parachute, with results that confirmed Cocking in the opinion that his new design gave a better performance. But as the construction on full scale involved a large and heavy machine—the weight being evidently a difficulty which Cocking fully realized—there was no balloon then in use large enough to ensure a safe trial, and though in 1835 he approached Frederick Gye, the manager of Vauxhall Gardens (where frequent balloon ascents were being made) on the subject, the suggestion was declined. The construction of the large Nassau (or Vauxhall) balloon in 1837 led to a renewal of the project, which, however, was not at once accepted, owing—at least in part—to an anticipation of the danger involved in the sudden release of so great a weight from beneath the balloon.

[1] Nicholson's *Journal of Natural Philosophy*, vol. xxv, 1810, p. 81. The title of Cayley's later article on 'Governable Parachutes' (*Mechanics' Mag.*, vol. 57, 1852, p. 242) is misleading—it deals (correctly speaking) with 'gliders'.

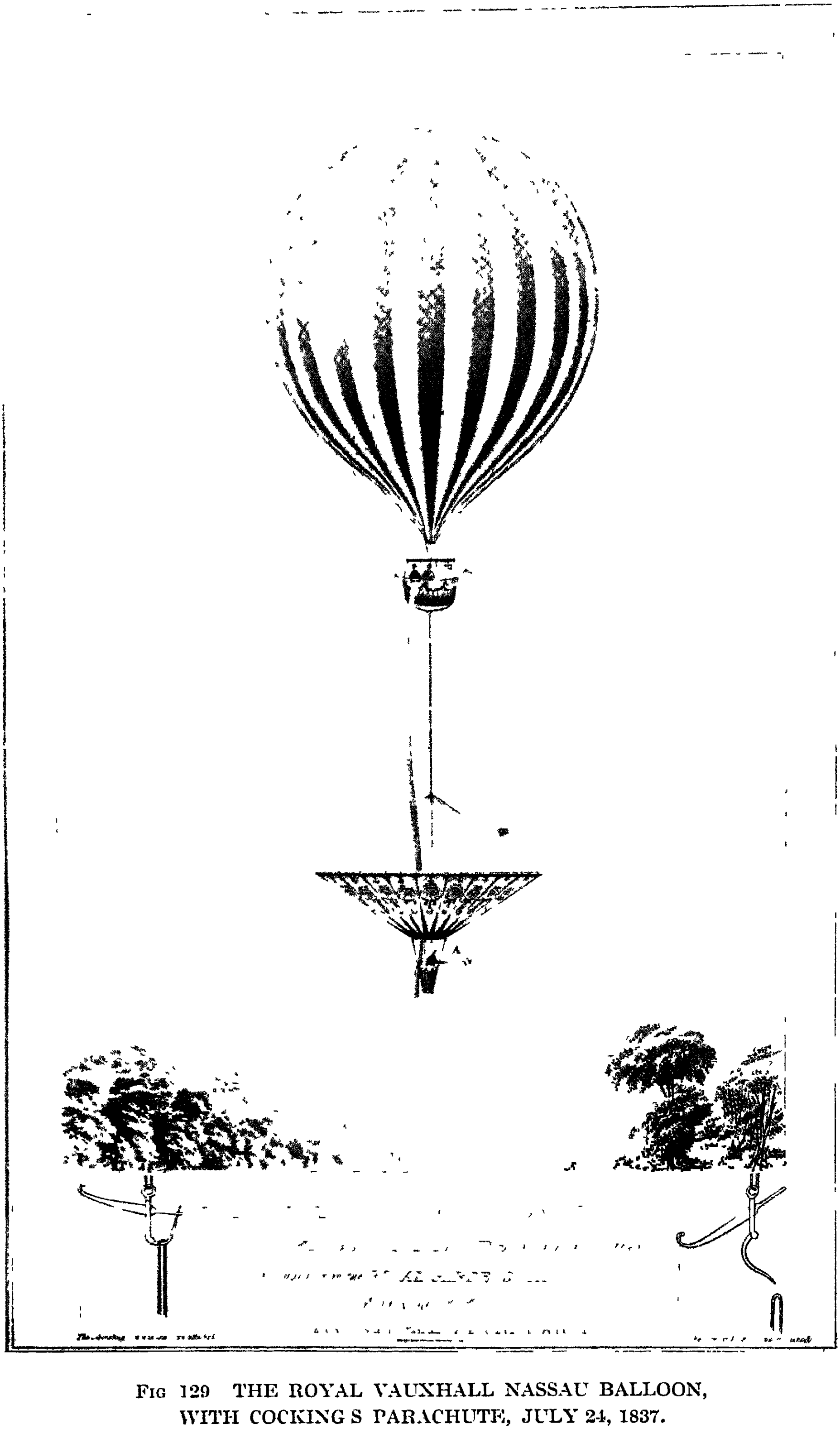


FIG 129 THE ROYAL VAUXHALL NASSAU BALLOON,
WITH COCKING'S PARACHUTE, JULY 24, 1837.

But in July of that year an agreement was concluded with Gye and Hughes, and in consideration of their undertaking the expense of construction, Cocking agreed to make a descent free of charge. Clearly his sincere enthusiasm led him to enter into this agreement as affording an opportunity for both the making of and testing his long-cherished hobby, though he incidentally agreed at the same time to make further descents for fees of 20 or 30 guineas. The parachute as constructed to Cocking's design and under his sole direction at Vauxhall Gardens (to avoid the difficulty of moving such a cumbrous machine), consisted in the main of three hoops or tubes, the uppermost measuring 107 ft. 4 in. in circumference and made of block tin, and the lowest—which, like the middle one, was of copper—measuring 4 feet.[1] This gave the form of an inverted cone at 30°, about 10 feet in height, the frame-work being connected by ten light spars of wood, braced by small lines stretching from the upper hoop to the lower. The whole was covered by twenty-two gores of fine cloth (or Irish linen), giving a surface of 124 square yards, against an estimated weight of 223 lb. To this had to be added Cocking's own weight, namely 170 lb., which according to the designer's own calculations would result in a fall not exceeding about 10 feet per second.[2] Beneath the vortex of the cone was a small basket, which Cocking thoughtfully—though with pathetic futility—fitted with inflated bladders to minimize any jar on landing.

Construction, of his Ultimate Design, 1837.

On the appointed day, July 24th, the Vauxhall balloon—piloted by Charles Green, accompanied by Edward Spencer—was inflated, and the parachute secured beneath.[3] As Green declined to be responsible for the release of the parachute, a device—termed a 'liberating iron'—was fitted, so that Cocking could himself let go at a favourable moment. Moreover, to ensure against any unforeseen difficulties, means were adopted whereby Cocking, if he so desired, could be drawn up into the car of the balloon. Persisting

The Fatal Descent, July 24, 1837.

[1] The parachute was elaborately decorated by E. W. Cocks, the scenic artist at Vauxhall Gardens. Cocks made an authentic scale drawing of the parachute and balloon (with details of the 'liberating iron'), which was published as a lithograph (Fig. 129). The Cuthbert Collection includes a small piece of the covering obtained by Cuthbert himself after the disaster.

[2] In his evidence at the inquest Monck Mason denied the accuracy of this calculation, and stated that he worked out the resulting velocity at 20 feet per second.

[3] It is noteworthy that whereas Cocking's death resulted indirectly from his having witnessed Garnerin's descent, the descendants of Edward Spencer (who was incidentally associated with Cocking) subsequently became well known as successful parachutists and as the makers of 'life-saving' parachutes.

in his determination to make the experiment, and in face of Gye's urgent suggestion that he should abandon it, Cocking—who it may be said was now in his sixty-first year—took his place in the small wicker basket, and about half-past seven on a beautiful summer's evening, the Vauxhall balloon rose slowly above the thousands of sightseers in the Gardens, the parachute suspended by a cord beneath. It was Cocking's desire that the balloon should rise to 5,000 feet before he let go, but owing to the difficulty Green experienced in discharging ballast, some time elapsed before that height was attained. The balloon was now between Greenwich and Blackheath, and as the surrounding fields afforded space for landing, Cocking announced to Green his intention of releasing the parachute. Soon afterwards he called up to the aeronauts above, 'Good-night, Spencer; good-night, Green', and immediately pulled the cord connected with the 'liberating iron'.[1] For three or four seconds the parachute was seen to descend with unlooked for velocity, then it crumpled up in the air as it fell, and within about three minutes Cocking had crashed to the ground in a field near Lee Green (Fig. 130). Though just alive when help arrived he never spoke again, and died in quite a short time. A few days later he was buried in the churchyard at Lee—a victim to the very dangers which, with the ardent but unscientific enthusiasm of the amateur, he had so long sought to overcome. Nevertheless, it may justly be added that in his unobtrusive determination and quiet courage, he exhibited no small measure of that unselfish devotion to an idea—even unto death—characteristic of much greater pioneers.[2]

The presence of certain tragic features in the disaster struck the public imagination, and the event consequently evoked an inordinate amount of attention in the press altogether out of proportion to its aeronautical interest, the subsequent inquest being reported verbatim, while several papers issued special illustrated supplements. At the inquest the story was told frankly and fully by Green and Gye, both of whom were wholly exonerated from blame. On the scientific side the statements of Sir George Airy, the Astronomer Royal (who had witnessed the descent through a telescope from Greenwich Observatory) and Monck Mason (who expressed in very dogmatic terms the opinion that on mathematical

[1] For an account of the subsequent course of the balloon see Ch. XI.

[2] Michael Faraday in a letter to the press at this time stated he knew Cocking as a member of the City Philosophical Society, and spoke of his 'abilities'. But it is evident Cocking's scientific attainments were inconsiderable and simply in the nature of a hobby.

Fig 130 COCKING'S FATAL DESCENT AT LEE, KENT
July 24, 1837

grounds an accident was inevitable) did not wholly make clear the actual nature or cause of the disaster, Cocking's death being simply recorded in the verdict as the consequence of serious injuries received from a fall in a parachute.

The attention thus called to the parachute naturally produced many new suggestions and designs, for the most part unpractical and unsupported by any experimental tests.[1] Indeed, Cocking's fatal end may well have discouraged further attempts, the more so in that the doubtful utility of the parachute—for any practical purpose at that date—cannot have appeared to justify the dangerous risks involved. When a further demonstration of the practicability of parachute descents from a balloon was forthcoming, it was made by a professional aeronaut, John Hampton, rather as a remunerative form of sensational entertainment than from any scientific motive. Some account of Hampton's exploits as a professional aeronaut have already been given in Chapter X. His first descent in a parachute was made early in his aeronautical career, at Cheltenham on October 3, 1838. The parachute was in the form of an umbrella 15 feet in diameter, with ribs made of ' very thick whale-bone ', 8 feet in length, connected to a copper tube (forming as it were the stick) by stretchers of bamboo. The covering was of ' prepared canvas ', and round the outside edge was an ornamental border or curtain, which ' by an admirable contrivance ' Hampton is said to have been able ' to contract or enlarge '—' as the sailor furls his sails '.[2] The car of wicker-work was strengthened by iron hoops to sustain the shock of landing, and was suspended from the balloon by a rope running through the central tube, the latter being 11 feet in height.

John Hampton's Parachute, 1838.

On completing the construction of the parachute Hampton sought to arrange for the inflation of his balloon at the town gas-works, but news of his proposed venture becoming known, scientific and influential men of the locality sought to dissuade him. The local press, doubtless having in mind the strong adverse feeling aroused against such exhibitions at the time of Cocking's death, also took up an attitude of hostile remonstrance. It was not surprising, therefore, that the manager of the gas-works sought the advice of the Cheltenham magistrates, who (though regretting that Hampton should persist in a project which, as they frankly

His First Descent, Cheltenham, Oct. 3, 1838.

[1] See *The Mechanics' Mag.* and *The Penny Mechanic* for August–November 1837.

[2] Presumably this refers to the fact that the parachute when ascending was closed, and Hampton opened it (like an umbrella) before descending (Fig. 133).

stated, they viewed with suspicion) doubted their power to prohibit it. An understanding was eventually arrived at which provided that if gas was supplied for the balloon, 'partial', that is captive ascents only, should be made. To this Hampton agreed, though in view of his subsequent admission it is quite clear he had no intention of abiding by it, his mind being 'resolutely fixed upon carrying out' his plan. On the day advertised, October 3, 1838, the balloon was inflated within the Montpellier Gardens, and the parachute was attached to it by a slip-line under Hampton's own direction. A strong rope was made fast to the parachute, and Hampton having stepped into the wicker basket the stay-lines were gradually paid out. When at a height of about 30 feet above the ground the determined aeronaut suddenly cut the ropes, and to the mingled surprise and consternation of the onlookers the balloon, with the parachute beneath, rose rapidly into the air. When at an altitude of about 9,000 feet Hampton, with nerves 'perfectly calm and collected', severed with a knife the rope attached to the balloon.

In a subsequent account of his exploit which opens with the declaration that this had been one of the happiest days of his life, Hampton looked back upon this moment as 'an awful one'—one which he imagined no man, though possessing 'the most cast-iron nerve', could regard without a quiver. On being released the balloon shot up and quickly burst—an incident which gave rise to the idea that it had caught fire. The descent of the parachute proved to be 'of the most gradual and progressive description', in a 'very easy and strictly perpendicular line', and without the least sense of danger. Indeed, had it not been that a bag of 30 lb. of ballast hastened the fall—the parachute being at times 'almost stationary'—Hampton states that he 'must have reached the ground under the most perfect, quiet, and pleasing gravity'. The descent occupied just under thirteen minutes—which worked out, according to the aeronaut's calculations, at 500 feet per minute—and the landing was effected at Badgeworth about five miles from Cheltenham.[1]

Second and Third Descents, June 13 and Aug. 12, 1839.

This exploit—the first successful descent of a parachute from beneath a balloon made in England since Garnerin's venture thirty-six years earlier—was renewed at Cremorne Gardens, Chelsea, on June 13, 1839, when Hampton is reported to have come

[1] Probably the fall was not quite so gentle as Hampton described. In a contemporary account in the *Essex Herald* it is said that his only injury was a 'slight wound on the eye-brow' (Fig. 133). The 'Guardian Angel' parachute developed on scientific lines during the Great War by E. R. Calthrop, falls when extended at the rate of 15 ft. per sec.

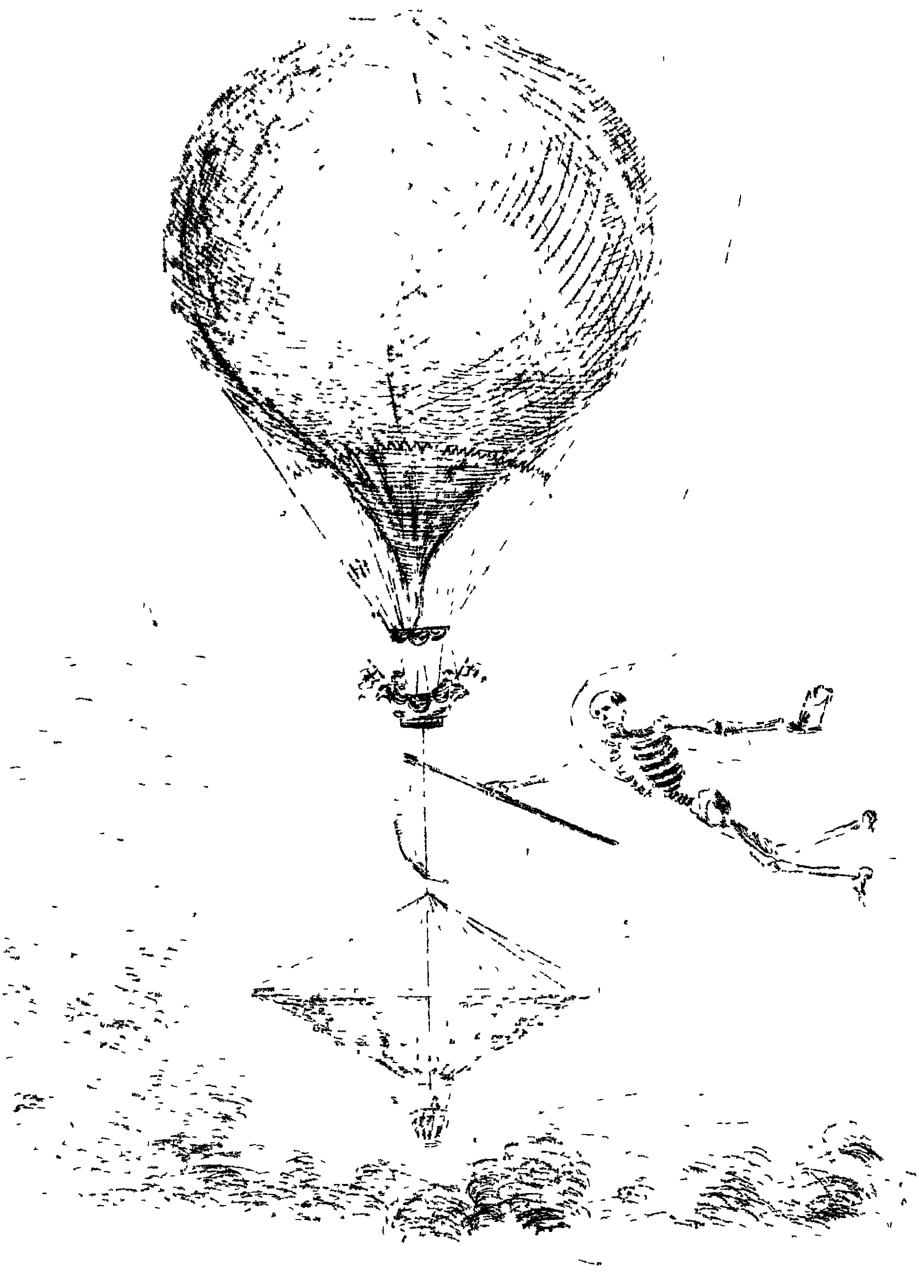
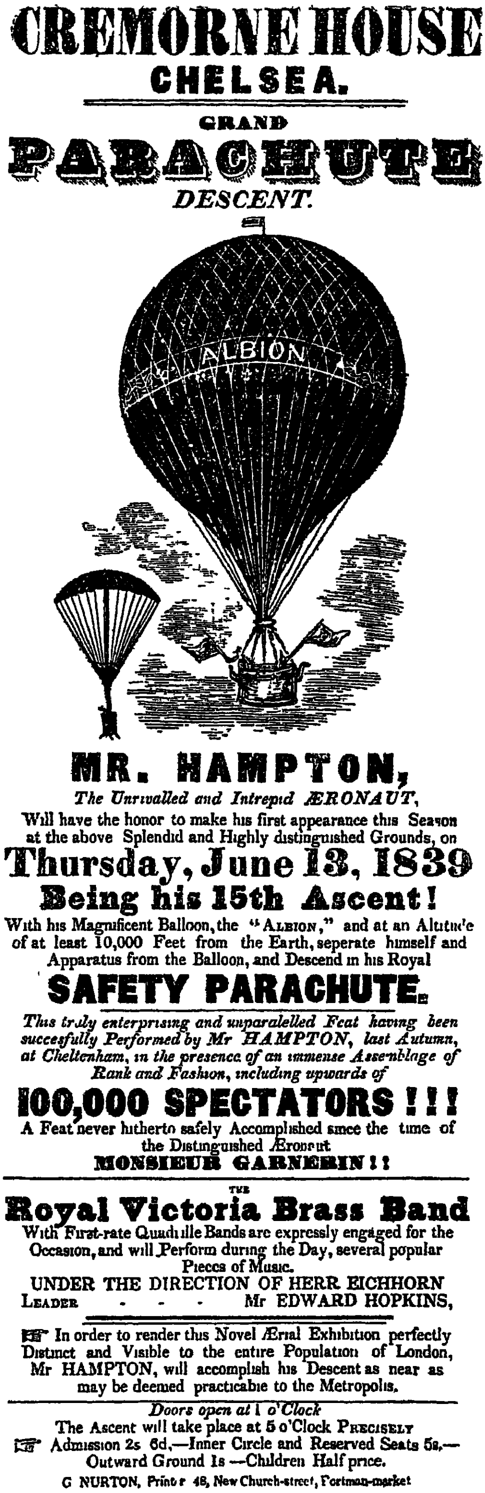


FIG. 131. ALLEGORICAL ETCHING OF COCKING'S PARACHUTE FATALITY, ONLY TWO IMPRESSIONS TAKEN OFF.

down 'in fine style, alighting on Fulham Road in perfect safety'. As a matter of fact the descent was not so successful as that at Cheltenham—mainly owing to the fact that, as Hampton explained in an aggressively apologetic account, he released the parachute at a low altitude so as to avoid being hidden in the clouds from the view of the spectators, and before he had been able to throw out the 42 lb. of ballast. His fall was evidently rapid, but he reached the ground in 'comparative safety' and without serious injury. On August 12th of the same year—the occasion of his twentieth ascent with the 'Albion' balloon, made from the Flora Tea Gardens, Bayswater—he essayed a third venture. The day was one of almost perfect calm and the balloon drifted slowly in the air, but when over Kensington Gardens Hampton, who held the opinion that the descent should not be made from less than 6,000 feet, deemed the moment a favourable one and released the parachute. At first he 'endured the usual dreadful sensation of being nearly suffocated'—a feeling which lasted for some seconds—but thereafter he floated gently downwards, alighting in the upper branches of a large chestnut tree close to the Palace. The branch giving



CREMORNE HOUSE
CHELSEA.
GRAND
PARACHUTE
DESCENT.

MR. HAMPTON,
The Unrivalled and Intrepid ÆRONAUT,
Will have the honor to make his first appearance this Season at the above Splendid and Highly distinguished Grounds, on
Thursday, June 13, 1839
Being his 15th Ascent!
With his Magnificent Balloon, the "ALBION," and at an Altitude of at least 10,000 Feet from the Earth, seperate himself and Apparatus from the Balloon, and Descend in his Royal
SAFETY PARACHUTE.

This truly enterprising and unparalelled Feat having been succesfully Performed by Mr HAMPTON, last Autumn, at Cheltenham, in the presence of an immense Assemblage of Rank and Fashion, including upwards of
100,000 SPECTATORS!!!
A Feat never hitherto safely Accomplished since the time of the Distinguished Æronaut
MONSIEUR GARNERIN!!

THE
Royal Victoria Brass Band
With First-rate Quadrille Bands are expressly engaged for the Occasion, and will Perform during the Day, several popular Pieces of Music.
UNDER THE DIRECTION OF HERR EICHHORN
LEADER - - - Mr EDWARD HOPKINS,

☞ In order to render this Novel Ærial Exhibition perfectly Distinct and Visible to the entire Population of London, Mr HAMPTON, will accomplish his Descent as near as may be deemed practicable to the Metropolis.

Doors open at 1 o'Clock
The Ascent will take place at 5 o'Clock PRECISELY
☞ Admission 2s 6d,—Inner Circle and Reserved Seats 5s,—Outward Ground 1s—Children Half price.
G NURTON, Printer 48, New Church-street, Portman-market

Fig. 132.

way beneath the weight Hampton fell to the ground and sustained some injuries, from which however he quickly recovered.

Hampton made four other descents in his so-called 'safety parachute' during the course of his ballooning career, but beyond proving that by means of his particular parachute (which he retained for exhibition purposes as late as 1851) it was possible to descend safely from a high altitude, he cannot be said to have developed the principle. Doubtless he lived to realize that the parachute might easily become 'a toy and a lure in the hands of a mountebank'—as was suggested by a typical anti-balloonist about that time—and indeed in later life he entered a strong protest against the suggested parachute descent of Madame Poitevin in London during September 1852.[1] The simple truth is that at this date there was no use for the parachute as a life-saving aeronautical device, for the technique of free ballooning was sufficiently understood to render the need of it as a means of escape in case of accident, unlikely in the extreme. Moreover, as both Green and Coxwell contended, and as other aeronauts have experienced, the envelope of a balloon itself can be made in an emergency to act as a parachute.[2] The sensational public spectacle which the parachute afforded was the main impulse—or temptation—to those who would run some risk to exploit it as a speculation, or as Hampton himself termed it 'for the sake of filthy lucre'. In July 1854, for instance, a French aeronaut, Letur, attempted an exhibition ('as a matter of speculation') from Cremorne Gardens, in a flying machine combining a parachute and wings actuated by treadles, carried up beneath a balloon piloted by W. H. Adams. Owing, however, to an accident in releasing the machine Letur was dragged over the tops of some trees in the neighbourhood of Tottenham, receiving fatal injuries from which he succumbed ten days later.[3]

Letur's Fatal Experiment, 1854.

But all such exhibitions—Baldwin, an American aeronaut,

[1] Poitevin and his wife had previously undertaken balloon ascents on horseback. In a letter to the *Morning Advertiser* in defence of the 'science' to which he had devoted his career, Hampton protested with 'unmitigated disgust' against such shameful exhibitions, and argued that the proposed parachute descent of Mme. Poitevin was nothing less than a brutal sacrifice.

[2] Fig. 98 depicts the experience recorded by Coxwell, Second Series, 1889, p. 22. See also Griffith Brewer on 'Parachuting Balloons' in *Theory of Balloons*, 1918 (quoted on p. 193 *ante*).

[3] Curiously enough Henry Coxwell, who witnessed the accident, was one of the jury at the inquest (op. cit., pp. 13–21).

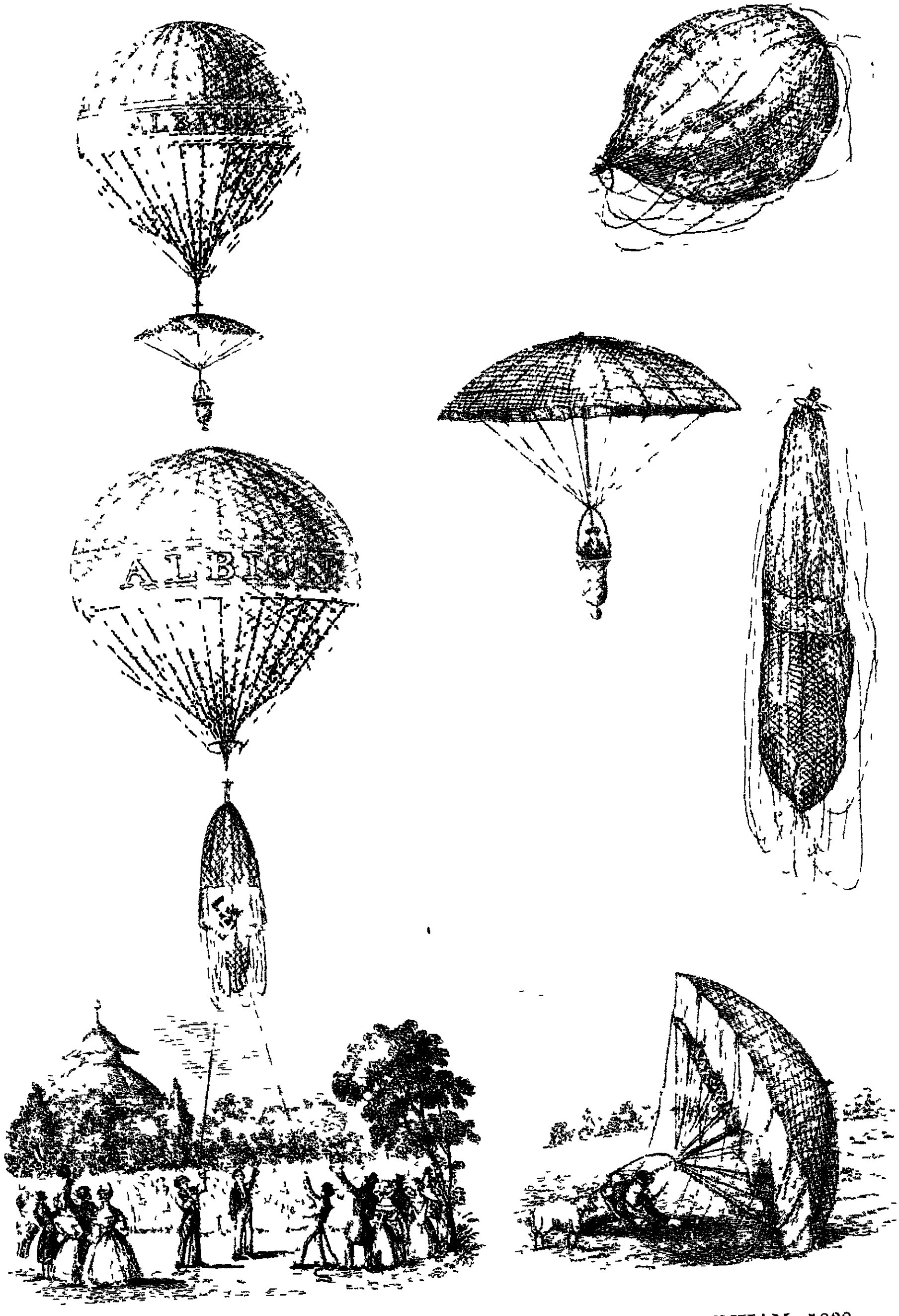


FIG 133 HAMPTON'S PARACHUTE DESCENT AT CHELTENHAM, 1838

made many descents in England during the 'eighties' by means of a simple silk parachute carried up hanging from beneath a free balloon—were essentially of the same character.[1] Indeed, it was not until there arose during the Great War an imperative need to devise an effective parachute—capable of being fitted in a small space, easily attached and readily released, and having an automatic, or positive opening, to ensure certain efficiency—that the seed of the invention planted in theory by Leonardo de Vinci over 300 years ago, came to fruition. As in other branches of aeronautical science the aerodynamics of the parachute are not even yet wholly understood or agreed upon; but its efficiency under certain conditions is fully recognized, and it can hardly be doubted that it will be yet further developed and may even become as generally adopted for life-saving in the air, as the life-belt is used for similar purposes of emergency at sea.

[1] The only patent specification for a flexible parachute (as a device for descending safely from a balloon) contained in Brewer and Alexander (which covers the period 1815–1891), is that of G. A. Farini and T. S. Baldwin, 1888, no. 10937. The Patent Office Abridgments (1856–1900) include only two or three specifications for improvements on the 'umbrella' or ribbed type of parachute, which has obvious impracticable features. On the other hand the Abridgments reveal that many inventors of both lighter and heavier-than-air machines proposed to use the principle of the parachute in case of emergency, mostly by the automatic operation of devices which formed part of the machine.

CHAPTER XV

THE EVOLUTION OF MECHANICAL FLIGHT

WITH A NOTE ON KITE FLYING

ANY comprehensive survey of the early periods of aeronautical history reveals the fact that the prevailing conception of flight up to the last quarter of the eighteenth century was based in the main on an imitation of the flight of birds. It has been seen that as early as the thirteenth century Roger Bacon had expressed his belief that the thing was possible, and might be accomplished by means of 'artificial wings made to beat the air, much after the fashion of a bird's flight'. Though Bacon's statement that he knew a man who had 'invented the whole artifice', does not appear to bear the interpretation put upon it by Robert Hooke in 1682, viz. that there was in Bacon's time 'another Person who had actually tryed it with good success', there is reason to believe that from century to century endeavours were made to achieve some measure of flight by winged apparatus. In his own day Hooke—a credible and scientific witness—informs us there were those who had 'employed their wits and time about this design'; he even named 'one Gascoyne' as having tried it with good effect forty years earlier, and stated that in his own day there were not wanting 'some in England, who affirmed themselves able to do it, and that they have proved as much by Experiment'. 'But of all these', he significantly added, 'we have little or no account of the waies they have taken to effect their designs, and therefore conjectures will be much at random'—remarks which remain true to this day.[1] Indeed, of all the endeavours made in Europe during the seventeenth and eighteenth centuries, to achieve flight by means of wings (made of various materials) actuated by the movements of a man's arms, or by both arms and legs, this much alone is clear—they were all destined to fail.

Roger Bacon, *c.* 1250.

The Persistence of the Idea of 'Winged Flight.'

Nevertheless, such was the strength and pertinacity of human desire and endeavour, that the experience of impotence, supported as it was by the scientific and carefully reasoned opinion adversely expressed by Borelli in his *De Motu Animalium*, 1680 (namely,

[1] See Ch. II, p. 78.

that man had not sufficient strength in the muscles of his arms and legs ever to be able to sustain his own weight in the air), did not suffice entirely to dispel, though it doubtless checked, hopes of achieving what was commonly alleged to be impossible. It has been seen that as late as 1780 Blanchard—having himself studied the flight of birds—was engaged in attempts to make a heavier-than-air flying machine, and his project, if the most prominent about that time, was certainly not the only one. Moreover, though the invention of the balloon, hailed at first as the final solution of an interminable problem, suddenly turned men's thoughts from ideas of flight as achieved by 'nature'—or as it was subsequently and in some measure erroneously termed, 'true flight'—it did not wholly suppress the older notion of flying by means of wings.[1] Indeed, the attitude of mind which resulted from the perception of two essentially different methods of attaining the ultimate aim of aeronautics, to wit navigation through the air, led to conflicting conceptions which are not wholly allayed to this day. The idea of flight—winged or mechanical flight, after the manner of birds—having proved a failure despite attempts extending over two hundred years, the sudden and—to a limited extent—completely successful method of the balloon, led to exaggerated hopes in the aerostatic method. But the limitations of the free balloon were realized at an early date, to be followed—as the present chapter relates—by fresh endeavours to realize mechanical flight. Such endeavours continued, on the one hand, to be barren to any practical extent, whereas on the other the balloon remained throughout the eighteenth century to enjoy a 'free' and spectacular existence.

The Antagonism between Mechanical Flight and the Principle of 'Buoyancy'.

As time progressed the futility of the balloon, save for exhibition purposes, led to an undue depreciation of its possibilities as an aeronautical machine, and thus—despite the admirable lead given by Cayley in his far-sighted prophecy as to the relative and complementary functions of the balloon and the mechanical flying machine—the two methods became antagonistic. This antagonism was forcibly but mistakenly expressed by the Duke of Argyle in *The Reign of Law*, 1866, wherein he characterized the balloon as a mere toy, for the 'principle of buoyancy' in which he found no

[1] Contemporaneously with Blanchard, C. F. Meerwein (1737–1810), an architect or surveyor of Karlsruhe, was working on a mechanical flying machine of the ornithopter type. See General Survey: Part 2, p. 44.

analogy in nature. Further, he especially approved of the title of the French 'Société d'encouragement pour la Locomotion Aérienne au moyen d'Appareils plus lourds que l'Air' (founded by Nadar) as conveying the 'true fundamental principle of flight', and, contrariwise, as eliminating the 'false principle of Buoyancy'.[1]

Early 'Winged' Flying Machines, 1783.

But to return to the story of mechanical flight in England. Probably the earliest extant description of a 'flying machine' is that to be found in the postscript to the small treatise on *The Air Balloon*, published in 1783. Prior to that date it cannot be said that anything in the nature of mechanism had been devised, save the simplest application of wings attached to and worked by movement of the arms.[2] As mentioned in an early chapter of the present work Johnson, in the story of *Rasselas*, 1759, expressed quite clearly the principle that the air must be capable of sustaining weight, if sufficient impulse be supplied to maintain the necessary pressure upon it, and it may be that such thoughts gave a stimulus to the inventive minds of the day. There is, for instance, in the *Oxford Magazine* of 1769 an engraving entitled 'A New Flying Machine upon Dr. Musgrave's Plan', which supports the suggestion. It is true the plate is primarily a caricature and may be wholly fanciful, but a 'new flying machine' certainly presupposes an older one, and the machine does appear to embody a misconception of the principle of utilizing the pressure of air in order to sustain a plane surface.[3]

The description of the machine referred to in *The Air Balloon* may best be given in the words of the anonymous author. Having related the intentions of a 'first philosopher' to render a balloon navigable, he proceeds:

'The second artist demands our wonder more, as he scorns the auxiliary of an Air Balloon, and means to traverse the air in what direction he thinks proper, by the assistance of a machine in the form of a canoe, to which are to be attached a pair of artificial wings and tail. This apparatus is now nearly compleated, the wings are nine feet by nine inches, the tail about

[1] Argyll (Duke of), *The Reign of Law*, 1867, ch. iii, 'Contrivance a necessity arising out of the Reign of Law'—Examples in the Machinery of Flight, pp. 128–80. See *ante*, Ch. XII, p. 280

[2] Cavallo (p. 294, note) states that William Wilkie (1721–72), 'the Scottish Homer', and professor of natural philosophy, suggested about 1755 that artificial wings for mechanical flight might be worked by straps or strings fastened to the feet with much greater power than could be exerted by the arms alone. Cf. Ch. IV, p. 106.

[3] See Grand Carteret, p. 150. The subject of the caricature is the controversy between Dr. Samuel Musgrave (1732–80) and the Chevalier d'Eon over the peace with France in 1763

a yard and a half long, both made of the purest elastic steel, and to be worked at discretion by the artist as he sits in his canoe. This wonderful attempt the Editor has seen and examined, through the courtesy of the Inventor who adds urbanity to a love of science. The wings are said to be constructed on the model of those of the West India crow; and the tail, though not so long, has somewhat of the plumage of a peacock. These the artist works with great facility, spreading and contracting both at pleasure, and he now only waits to commit them to the air till a second pair of wings are ready for him to use in case of any accident happening to the first.' (Op. cit. p. 34.)

It is not improbable it was to this machine that Johnson referred in a letter to Mrs. Thrale in January 1784, when he told her of 'a daring projector, who, disdaining the help of fumes and vapours, is making better than Daedalean wings, with which he will master the balloon and its companions as an eagle masters a goose'. 'It is very seriously true', he continued, 'that a subscription of eight hundred pounds has been raised for the wire and workmanship of iron wings—one pair of which, and I think a tail, are now shown in the Haymarket, and they are making another pair at Birmingham. The whole is said to weigh but two hundred pounds —no specious preparation for flying, but there are those who expect to see him in the sky.'[1]

The Lack of Aerodynamic Data.

That expectation was destined to be deferred for more than one hundred years. Doubtless the invention of the balloon at this period tended to divert attention from mechanical flight, and certainly little or no data in the science of aerodynamics, of a kind that would have been helpful in laying down the principles of mechanical flight, was adduced by the physicists and mathematicians of the eighteenth century—nothing at least which was comparable to the discoveries of the chemists of that period, in so far as they led directly though incidentally to the invention of the balloon. It is true that as far back as 1661 Hooke had read a paper before the Royal Society on the 'Resistance of Air to bodyes moved through it', and that he made experiments in 'shooting horizontally from ye top of some tower . . . several kinds of bodys', with the intention of accurately observing how long they remained 'in the air before they touch the ground'.[2] At a

[1] Johnson's close connexion with Birmingham adds interest to this statement. It is not generally known that Johnson was interested in mechanical concerns—he was associated in an endeavour to develop the invention of the first spinning machine by John Wyatt, of Lichfield, in 1733. See Johnson (S.), *Letters*, ed. Birkbeck Hill, two vols., 1892.

[2] Royal Soc.: *Classified Papers*, vol. xx, no. 1.

later date Sir Isaac Newton (in 1710) and J. T. Desaguliers (in 1719) carried out experimental work on the resistance offered by the air to spherical bodies, while Colin Maclaurin, an apostle of Newton, made calculations on the sustaining power of the kite.[1] In 1746 Benjamin Robins, a distinguished mathematician and the reputed author of the earliest form of whirling table, read a paper before the Royal Society on 'Resistance of Air, together with the Method of computing Motions of Bodies projected in that Medium' —the latter calculations being mainly concerned with ballistics.[2] Following up the work of Robins another eminent mathematician, Charles Hutton, undertook in 1787–9 experiments relative to the pressure of air on inclined planes, also made by means of a 'whirling table', a laboratory instrument which was likewise used by Hutton's contemporary, Samuel Vince.

But though it be admitted that the most valuable results by no means always come from research work directed to the elucidation of specific problems in science or mechanics, it must likewise be allowed that the data derived from the experimental work above mentioned had but little bearing on the aerodynamics of flight. Nevertheless, it is notable that Hutton—who laid down the 'determination of pressure velocity law' in the formula, 'P varies as V2'—appreciated the importance of 'aspect ratio', while in 1800 Thomas Young made observations on the conduct of curved surfaces when suspended in a horizontal current of air.[3] It is even more remarkable that the first man in England to break away from the old ideas of winged flight and boldly propound the principles of flight as a mechanical problem, should have done so at the close of the eighteenth century in despite of the wholly inadequate knowledge of aerodynamics then prevailing.

Sir George Cayley (1774–1857).

It is to Sir George Cayley that must be accorded the distinction of having first applied the mind of a scientist and engineer to the problems of mechanical flight, with which he combined practical experiments on a considerable scale. He deserves to stand among the great pioneers of aviation and in the direct line of descent between such names as Leonardo da Vinci and John Stringfellow. Alphonse Berget's tribute to the effect that Cayley's name must be

[1] *Mechanics' Mag.*, vol. xxxviii, 1843, p. 317, where Maclaurin's authority is used to controvert Henson's statement that 'a kite has the greatest sustaining power, when fixed at an angle of 45°'.

[2] Robins (B.), *Mathematical Tracts*, by Wilson, two vols, 1761, vol. i, p. 202 and plate.

[3] Langley (S. P.), *Experiments in Aerodynamics*, 1891, p. 63.

inscribed 'in letters of gold, at the beginning of the history of the aeroplane', deserves quotation not less because it is true, than because it is the impartial homage of a Frenchman.[1]

His Early Interest in Aeronautics, 1796.

It has been seen that Cayley's interest in aeronautics was aroused in boyhood by the invention of the balloon in 1783. He himself tells us that his first experiment in such matters was made as early as 1796, with a Chinese or aerial top, which served at once to illustrate the principle of the helicopter and the air-screw. Though but a toy of a few inches in length, its capacity to demonstrate certain elementary but important principles in aeronautics made a lasting impression on Cayley's youthful mind, and only three years before his death he sent to Dupuis Delcourt a drawing of one which he had had made, the best he had ever seen, and capable of rising 90 feet in the air.[2]

His First Essays 'On Aerial Navigation' [Mechanical Flight], 1809–10.

Having collected a body of 'facts and practical observations in the course of much attention to the subject'—to use Cayley's own words—he published his first essay 'On Aerial Navigation' [Mechanical Flight] in the pages of Nicholson's *Journal of Natural Philosophy* for November 1809. The scientific character of his previous observations and experiments is revealed in his ability to grasp those essential principles, an adequate appreciation of which could alone render progress possible. His reflections on bird flight led to the belief—confirmed by so great an observer as Charles Darwin nearly twenty-five years later—that flying required less exertion than was then commonly supposed.[3] But he categorically denounced the idea of flight by means of wings (worked by muscular effort) as ridiculous. In his clearly expressed conviction that mechanical flight—with which this first essay deals—was possible, and in his enunciation of the 'whole problem' as contained in the simple but comprehensive formula, 'To make a surface support a given weight by the application of power to the resistance of air', he is revealed as the earliest true pioneer of the aeroplane. He had perfect confidence in the practicability of

[1] Berget (A.), *The Conquest of the Air*, 1909, p. 242. For some account of Cayley's equally important contributions to the development of airships see Ch. XIII of the present work.

[2] Fig. 135. The original of one of these aerial tops is still in the possession of Mrs. Thompson, a granddaughter of Sir George Cayley, to whom the writer is indebted for the story of the 'flying coachman' on p. 346.

[3] Darwin (C.), *A Naturalist's Voyage*, 1845. From watching the soaring movements of condors, Darwin concluded that the 'force to keep up the momentum of a body moving in a horizontal plane in the air cannot be great'. See Means, 1895, p. 129.

transporting passengers and goods—the latter word is expressive of his large ideas—'more securely by air than by water, and with a velocity of from 20 to 100 miles per hour'.

His Experiments with Gliders, 1808.

His earlier experiments in aerodynamics had revealed that a surface of one square foot, moving at a velocity of 11·538 feet per second, generated resistance equivalent to 4 oz., or at 17 16 it gave 8 oz. With some such data he proceeded to make 'gliding' experiments on what he called 'a considerable scale of magnitude'—apparently with a machine having a surface of 300 square feet—and his enthusiastic description of one of the trial flights (made from the high ground behind Brompton Hall) calls for quotation as being the first of its kind. 'It was very beautiful', he wrote, 'to see this noble white *bird* sail majestically from the top of a hill to any given point of the plain below it, according to the set of its rudder, merely by its own weight, descending in an angle of about 18° with the horizon.'[1] Cayley states that the upward lift of this 'gliding' machine was at times so strong that any one running forward in it against a light breeze would be raised from the ground for 'several yards together'. It is probably of one of these trials that the story is told of 'the coachman being sent up in it', when 'it flew across the little valley—about 300 yards at most—and came down with a smash'. Fortunately the experiment had at least an amusing termination, for, struggling to his feet, the Jehu—doubtless caring little for the historic character of his aerial experience and scared at being thus unwittingly transformed into a Phaethon—approached Cayley and in the broadest Yorkshire dialect said, 'Please, Sir George, I wish to give notice. I was hired to drive, not to fly!'[2]

But even at this date Cayley's thoughts were also engaged on the question of propulsion, or the necessity of a 'first mover' as he termed it. Realizing that a steam-engine of the type recently invented by Boulton and Watt would be inadequate, he looked more hopefully to the development of some such engine as was reported to have been designed by William Chapman of Newcastle—an early form of internal combustion engine, with oil of tar as fuel—or to his own suggestion of a gas-engine. There is reason to

[1] Nicholson's *Journal of Phil.*, vol. 24, 1809, pp. 164–74. Reprinted by Means, 1895, and in Aeronaut. Classics, No. 1, 1910, in neither case quite *literatim*.

[2] The site of this story is linked, by an interesting coincidence, with modern flight, for a great-grandson of Sir George Cayley flew down from Scotland during the Great War and landed (as Mrs. Thompson informed the writer) near the very spot.

Fig 134 SIR GEORGE CAYLEY.

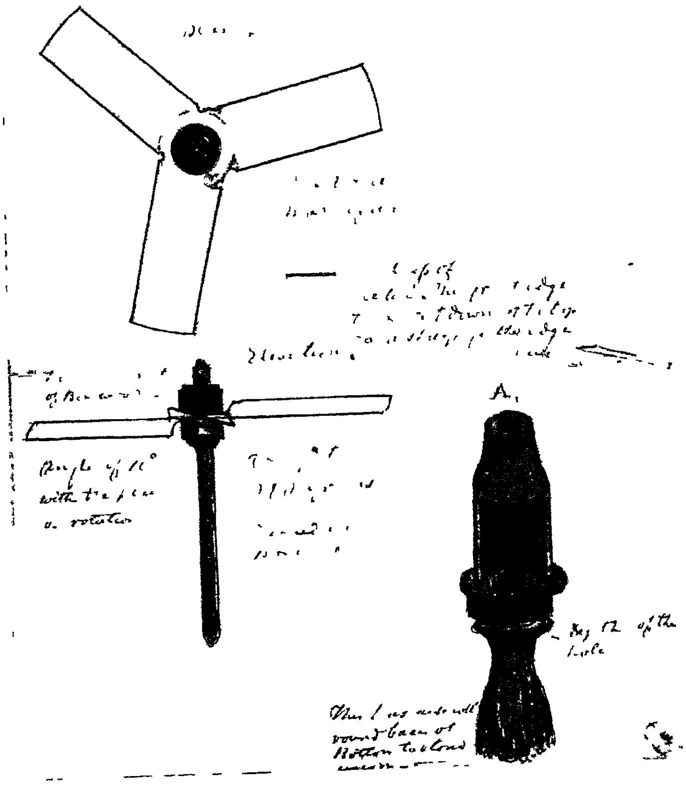


Fig 135 CAYLEY'S IMPROVED CHINESE FLYING-TOP

believe that Cayley not only endeavoured to construct a gas-engine, but that he also conceived electricity might prove a possible motive power for aeronautical purposes. Evidently he intended to make some trial of a 'propelling apparatus' with his 'glider', for he refers to the fact that an accident (conceivably the one above related) prevented his doing so. He continued, however, to consider many other factors involved in mechanical flight, and in a further contribution to Nicholson's *Journal* in March 1810, he dealt with questions of initial velocity, the leverage on the wings, and the need for lightness in construction combined with strength, the latter capable of being overcome by designing superposed surfaces, as now usual in the bi-plane. The wings, he conceived, should be supported by 'diagonal bracing'—which he termed 'the great principle for producing strength without accumulating weight'—while he foreshadowed the necessity for stream-line design in the maxim, that 'in the art of aerial navigation, every pound of direct resistance, that is done away with, will support 30 lb. of additional weight without any additional power'.

At a later date—as recorded in the previous chapter—Cayley turned his mind to the problems connected with the navigation of balloons, but on the publication in 1843 of particulars of Henson's 'steam carriage', he returned to the subject of mechanical flight, and gave expression to his opinions in two letters to the *Mechanics' Magazine* in April 1843. His criticism of Henson's scheme, though accompanied at the outset with an expression of encouragement and marked throughout by moderation of tone, clearly indicated his reasoned doubts as to its success. In the first place, 'the magnitude of the proposed vehicle', involving a terrific stress on the necessarily light structure of the main supporting surfaces or wings—measuring, as designed, 150 feet across—afforded ground for serious misgivings. The stress or 'leverage' on the wings, Cayley again suggested, might be overcome by securing the required surface, not 'in one plane, but in parallel planes one above the other', and he went so far as to propose a tri-plane, or 'three-decker', as he termed it. Moreover, while expressing his conviction 'that the inclined plane, with a horizontal propelling apparatus, is the true principle of aerial navigation by mechanical means,' Cayley doubted Henson's ability to provide the very great engine power —'the *sine qua non* of the case'—which the design required.[1]

[1] Cayley reverted to his experiments with gliders in a letter on 'Governable Parachutes' contributed to the *Mechanics' Mag.*, vol. 57, 1852 (p. 242). See also Bibliography, p. 412.

Fig 1

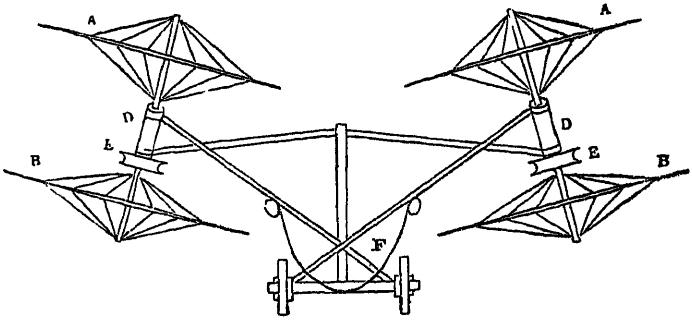


Fig 2

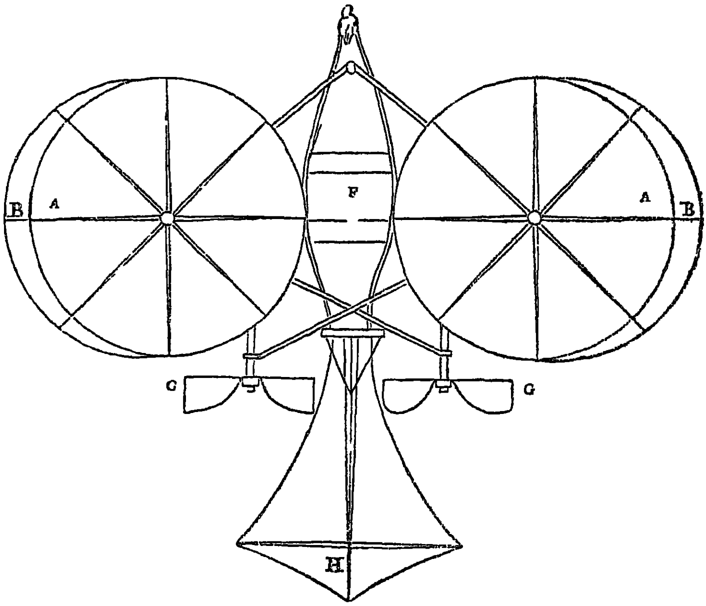


Fig. 3.

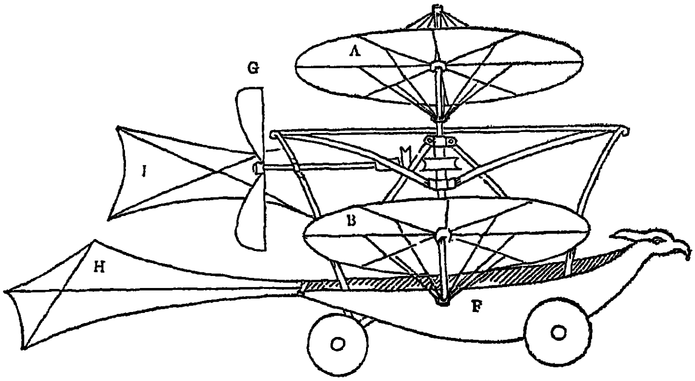


Fig. 136.

As in the case of navigable balloons, Cayley's design for an 'aerial carriage' (which he described in the same paper) is hardly as interesting, and certainly not as sound, as his examination and discussion of theoretical principles. His plan (Fig. 136) shows that instead of obtaining the required supporting surface by means of horizontal wings, he proposed two sets of superposed circular planes (designed when in motion to act as helicopters), set at an obtuse angle, and revolving in contrary directions. These circular planes he termed 'elevating fliers', to distinguish them from two smaller air-screws for propelling the machine. The 'framing' or fuselage was to be covered with canvas at once to increase the surface and afford protection to the engine, while a 'broad horizontal rudder, or tail', was to give direction in ascent or descent, with a small vertical one to afford lateral guidance.

His own Design of an 'Aerial Carriage', 1843.

It is hardly likely, however, that at this late period of his career Cayley made any attempt to construct such a machine, though he was experimenting with 'gliders' up to within a few years of his death. Moreover, his faith in the 'lighter-than-air' method was significantly reasserted in this mature contribution to aeronautical science, for he again urged the opinion that 'balloon navigation' (for the reasons he had previously and fully explained) is 'that designed for the uses of mankind on the large scale'.

Thomas Walker (*ca.* 1785–1835).

It has been seen that Cayley's work in the field of aeronautics was not only on a wide scale, but combined theoretical considerations with practical experiments. The ideas of his contemporary, Thomas Walker, were mainly of a theoretical character, and found expression in his *Treatise upon the Art of Flying by Mechanical Means*, first published in 1810. Nothing appears to be known of the life of the author, beyond such meagre facts as may be gathered from his book. On the title-page of the first edition he is described as a portrait painter of Hull—where his book was published—and from the reference to himself (in the eulogistic dedication to Earl Stanhope) as an 'obscure individual', it is evident his reputation as an artist, or indeed in any capacity, was limited to a small circle.[1] From certain passages in the treatise which give expression to personal feelings—his detestation of war, or the savage art of murder, as he terms it; his wholly admirable plea in support of

[1] Walker is referred to by a writer in the *Mechanics' Mag.* (vol xiii, 1830, p. 350) as a 'gentleman of great talent', unassuming but communicative, save in the presence of 'the critic, the wit, or the more heavy part of mankind, who are too tiresome to instruct'.

A

TREATISE

UPON THE

ART OF FLYING,

BY MECHANICAL MEANS,

WITH A

FULL EXPLANATION OF THE NATURAL PRINCIPLES
BY WHICH BIRDS ARE ENABLED TO FLY,

LIKEWISE

INSTRUCTIONS AND PLANS

FOR MAKING A FLYING CAR WITH WINGS, IN WHICH A MAN MAY SIT, AND, BY WORKING A SMALL LEVER, CAUSE HIMSELF TO ASCEND AND SOAR THROUGH THE AIR WITH THE FACILITY OF A BIRD

ILLUSTRATED WITH PLATES.

BY THOMAS WALKER,
PORTRAIT PAINTER, HULL.

HULL:

PRINTED BY JOSEPH SIMMONS, AT THE ROCKINGHAM-OFFICE;
AND SOLD BY LONGMAN, HURST, REES, & ORME, LONDON;
AND BY ALL THE PRINCIPAL BOOKSELLERS IN
TOWN AND COUNTRY.

1810.

Fig. 137.

'the pure and tranquil delights resulting from the universal study of nature', and his burning indignation over the brutal sport indulged in by 'wanton barbarians' who resort to Flamborough Head for the purpose of bird shooting as a mere amusement—the opinion may be hazarded that the author's life was a narrow, uneventful one, devoted to a secluded art in which he achieved but little fame,

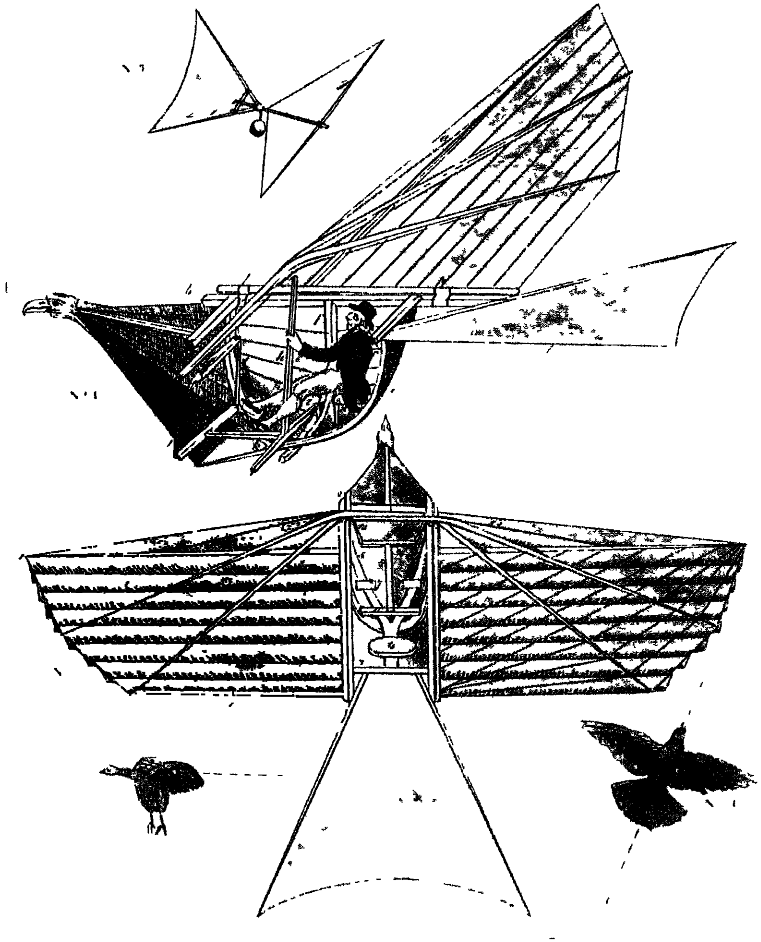


Fig 138 Frontispiece to the First Edition of Walker's *Art of Flying*, 1810

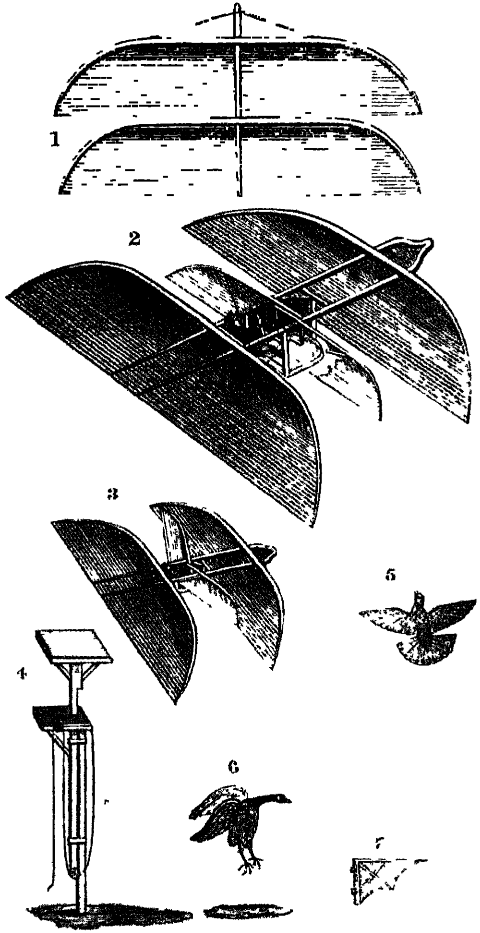


Fig 139 Frontispiece to the Second Edition, Bristol, 1831

and with which he combined an observant and studious interest in the works of nature. But though Walker's mind may have been of a superior order, and though the excellence of his prose denotes a considerable degree of culture, he had no special aptitude for pure science and probably less for mechanics. In these respects he must be allotted a much lower place than Cayley, to whose ideas he refers as coincident with his own. 'When my work', he writes in the Preface, 'was just ready for the press, I was much surprised at the account a friend gave me of what he had seen that day upon flying, in a monthly journal. I immediately procured a sight of it, and found it to be an ingenious paper, written by Sir George Cayley; and I own I was astonished at the perusal. I conceived it to be very extraordinary that two persons, not having the least knowledge of each other, should be publishing their thoughts at the same time, upon such a subject; nor was I less surprised to find the subject treated of there, in a manner so rational, and far superior to anything I had ever seen before.'

It is evident that Walker's book became more widely known in the author's lifetime than the author himself. In the second edition of 1831 which appeared at Bristol—whither Walker had presumably moved—under the new title of *A Treatise upon Aerostation*—an unnecessary, not to say inaccurate, revision—the author refers to copies having been 'taken into Holland, Germany, France, America, and other countries', while actual reprints were published in New York in 1814 and 1816. Moreover, it is curious that when in 1827 Hugh Bell wrote to the *Mechanics' Magazine* on the subject of this 'scarce' and 'curious pamphlet'—which he viewed as containing a 'sound, rational, and scientific theory on aerostation', and of which an abridged reprint followed his communication—he stated that on making inquiries respecting the author, when passing through Hull a few years before, 'he was not to be found', a fact which suggests that Walker's removal to Bristol had passed unnoticed.[1]

His *Treatise on Flying*, 1810.

Walker's ideas on the practicability of flight as a means of aerial transportation were based (as stated on the title-page of his treatise) upon 'the natural principles by which birds are enabled to fly'. It is evident the flight of birds was a subject on which for many years he diligently read and observed—in his early life he

[1] *Mechanics' Mag.*, vol. vii, 1827, pp. 130, 154, &c. (For Hugh Bell see Ch. XIII of this work.)

dissected many birds and 'studied very minutely the mechanism of their wings, tails, and all the parts which they employ in flying'. On the evidence of his reading—which reveals an unusual reference to Willughby, and which the author himself states would have enabled him to compile a large volume from all that had been said on the subject throughout the ages—he avers that 'no one has ever understood the natural means of flying', and he dismisses as 'childish whims' all attempts hitherto made with wings, whether of silk, leather, sheet iron, or other materials. Throughout the book he insists on the fact that granted the possession of the 'two greatest requisites' for flying, viz. 'wings large enough' and 'sufficient power to work them', the weight of a bird—or of a man—is no obstacle to the art of flying. He contrasts the weight of a humming bird—one drachm—with that of a condor, which he takes at not less than four stone—or 14,336 times as heavy as the smaller bird—the wing-spread of the latter measuring no more than three inches, while that of the condor is said to extend to twelve feet from tip to tip. Having examined the construction and application of the wings of a bird, he states his conclusion in the following words:

> 'When a bird, by the power of its pectoral and deltoid muscles, puts its wings into action, and strikes them downwards in a perfectly vertical direction upon the air below, that air being compressed by the stroke of the wings, makes a resistance, by its elastic power, against the under side of the wings, in proportion to the rapidity of the stroke and the dimensions of the wings, and forces the bird upwards; at the same time, the back edges of the wings being more weak or elastic than the fore edges, they give way to the resisting power of the compressed air, which *rushes upwards past the same back edges,* acting against them with its elastic power, and thereby *causes a projectile force,* which impels the bird forwards; thus we see that by one act of the wings the bird produces both *buoyancy* and *progression.* When the tail is forced upwards, and the wings are in action, the bird ascends, and forced downwards it consequently descends; but *the most important use of the tail is to support the posterior weight of the bird,* and to prevent the vacillation of the whole.'[1]

In respect of his own scheme for 'artificial flying' which, conceived on an analogous plan, was designed to overcome the difficulty of the insufficient strength of man's arms, and (as hitherto attempted) the unsupported weight of his body—he claimed, with that complete assurance which is rarely convincing, '*there cannot remain a doubt*

[1] *Treatise on the Art of Flying,* Aeronaut. Classics, No. 3, 1910, p. 12.

of success '. Walker admits that ' professional Avocations and other circumstances '—which it is safe to assume included lack of money —prevented him from making any such machine as he described on paper, and indeed the only experiment he himself records was confined to diminutive paper models. It should, however, be added that a contemporary—who as a resident of Barton-on-Humber doubtless wrote with some personal knowledge—stated that Walker made a machine, but ' was unable to raise himself from the platform on which the car was placed '. Moreover the same writer, in a critical examination of Walker's ideas, demonstrated by mathematical calculations that the wings proposed and the device for applying manual power were wholly insufficient. The wings in question were ' 12 feet long each, by about 6 feet broad ', the framing of them being of wood and whalebone, covered ' with silk in narrow screeds with whalebone springs, to open for the air to pass through in their upward strokes '.[1] In the 1810 edition two crude plans of the machine are given (Fig. 138), and they probably convey the mechanical features of the design as clearly—or as inadequately—as the textual description. But between the first edition and the later one of 1831 Walker's ideas had in some respects become modified—in the opinion of Wing Commander Hubbard his knowledge had increased—and an entirely new design for the flying machine is given on the plan, with corresponding variations in the text. As may be seen from the reproduction (Fig. 139) it embodied a feature—the front and rear position of the two ' passive surfaces ' or ' planes ', with the pilot working the ' active wings ' amidships—which is uncommon, but which bears a resemblance to Langley's famous Hammondsport machine of 1903.[2] One addition to the description of the machine as given in the 1831 edition may be mentioned, namely Walker's suggestion that if after a full trial his machine failed, the wings might be made to contain hydrogen gas in order to ' increase the sustaining power '.[3] It is true

[1] *Mechanics' Mag.*, vol. xiii, 1830, pp. 324, &c. Another writer (op. cit., vol. xxx, p. 350) states that he saw Walker's ' model when it was finished . . . a slight fragile machine ' made for experiments in 1810. Walker's assurance is well exemplified in the title to the 1810 edition. The sentence as to soaring through the air ' with the facility of a bird ' was modified in 1831 to ' with great facility '.

[2] Cf. Fig. 139 and *Aeronaut. Journal*, vol. xxv, 1921, p. 634, &c.

[3] In his letter to the *Mechanics' Mag.* (referred to on p. 351, *ante*), H. Bell stated that as an addition to the plan in the pamphlet, Walker ' proposed to fix a triangular parachute on a light mast over the aeronaut ', to supply the dual purpose of a safety device and additional suspensive power.

Walker expressed his firm conviction this would prove to be unnecessary, but—as being an impracticable and unscientific combination of two different principles—it cannot be said to add to his repute as a pioneer in the field of aeronautics.[1]

The work of Cayley and Walker—the former, doubtless, in a more direct sense than the latter—clearly led up to the ambitious schemes of Henson and his so-called 'First Carriage, The Ariel', and in the latter's subsequent association with John Stringfellow, the story of mechanical flight comes within measurable distance of ultimate success. Not that the principles so ably enunciated by Cayley obtained general acceptance—new ideas, however rational and sound, seldom supplant older ones save by slow degrees, and the old notions of wings, manual power, and so forth, still persisted.

Mayer's Experiments at Worcester, c 1825.

For instance David Mayer in a paper on 'Mechanical Flight', read before the Aeronautical Society in 1868, referred to experiments he had made at Worcester more than forty years earlier, in an endeavour to obtain flight by means of spiral or screw-shaped surfaces, based on the use of manual power alone.[2] Moreover, as late as 1843, W. Miller published under the misleading title of the 'Aerostat worked by Manual Power', an engraving of a flying machine of the ornithopter type, designed to be actuated by arms and legs (Fig. 140). If it now retains any sort of interest it can only be by reason of the fact that it depicts what must be among the last conceptions of the kind, thus closing (at least in so far as this book relates) a story of endeavour reaching back through the ages to the ninth-century legend of King Bladud.[3] The effective lithograph of Miller's 'Aerostat' sufficiently conveys his admirably simple notions, but a plan with descriptive text is shown in the margin.[4] From the latter it may be gathered that the wings were made of

Miller's 'Aerostat', 1843.

[1] It should be noted that Thos. Walker was not the only one of that name interested in mechanical flight at this period. In June 1833 a 'Mr. Walker, Professor of Astronomy' in a lecture at the Guild Hall, Lincoln, explained 'his theory for Navigating the Air by mechanical means, without either gas or balloon', and exhibited 'a Machine with a small Boat under it, actually flying over the heads of the audience without anything but the Air to support it'. *A Treatise by Mr. Walker on Mechanical Aerostation* was on sale at the lecture.

[2] *Aeronaut. Soc. Third Report*, 1868, p. 56.

[3] Later designs for similar apparatus worked by manual effort were published in France by J. J. Boucart and Dandrieux in 1866 and 1879 respectively.

[4] Miller's name—followed on the print by the academic letters M.R.C.S.—is rarely mentioned in aeronautical books, and nothing else appears to be known of his interest in flying. Grand-Carteret (p. 2) reproduced an impression of the lithograph with text in French.

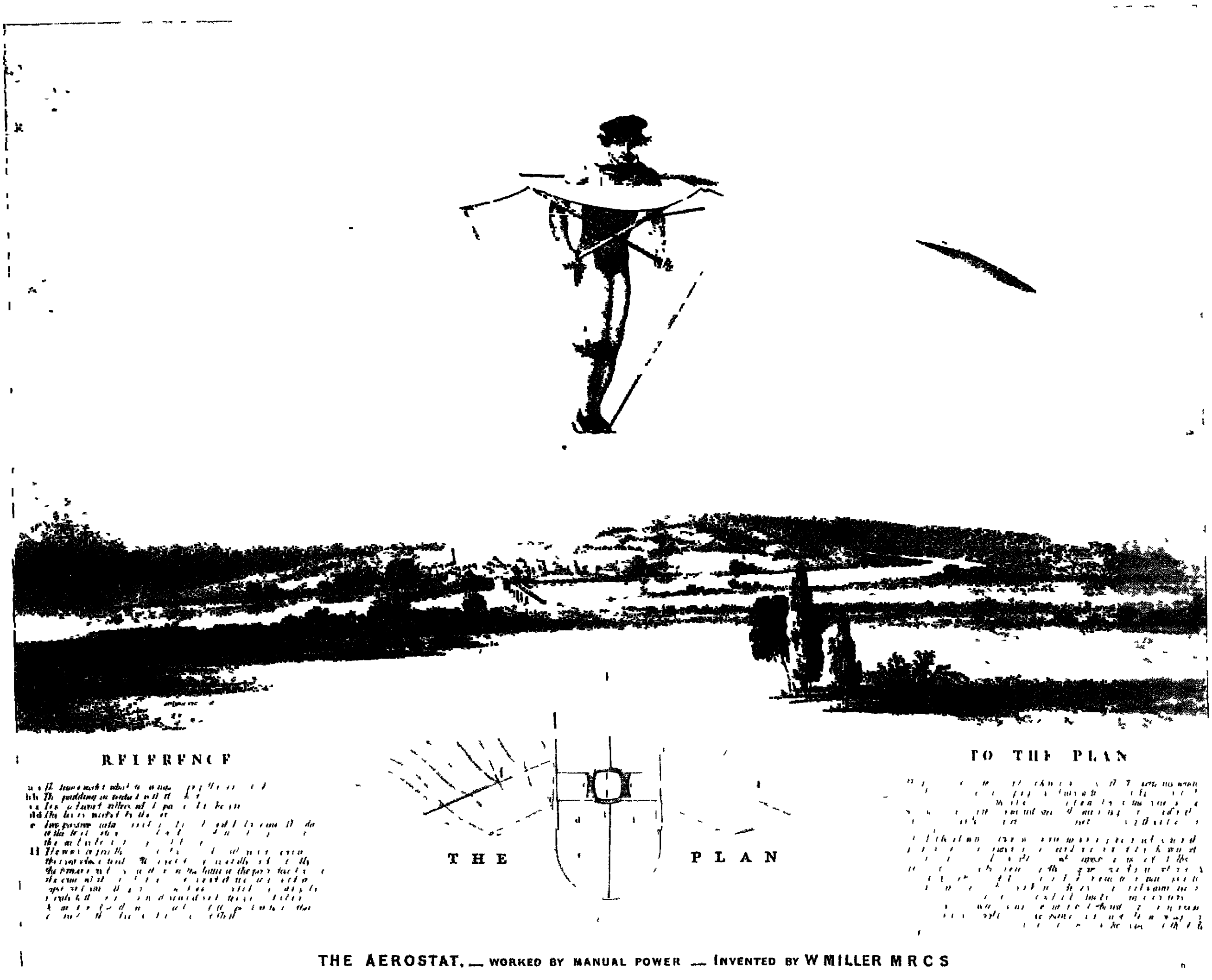


FIG 140 MILLER'S 'AEROSTAT', WORKED BY MANUAL POWER, 1843

oiled silk and hollow canes—a material used in 1896 by Pilcher in his glider the 'Hawk'; that they tapered off towards the trailing edge so as to yield readily to the air on the downward stroke; that there were two small 'passive surfaces' in front and rear of the aeronaut, and that the 'whole apparatus' (having a wing-spread of about 17 feet) weighed just on 15 lb.[1]

Henson and Stringfellow.

But to revert to the schemes of William Samuel Henson, whose name must always be associated with that of his more able colleague John Stringfellow, to whom belongs the distinction of being the first man to design a model engine-driven aeroplane which flew.

William Samuel Henson (b. 1805).

Of the early life of William Samuel Henson very little is known.[2] He is said to have been born at Leicester about 1805, and having become an engineer he developed a keen interest in the problem of flight. He was living with his father at Chard in Gloucestershire, when John Stringfellow moved there in 1820. Mutual interests in engineering and aeronautics brought the two men together, and when shortly afterwards Henson—doubtless in the hope of furthering his aeronautical aims—went to live in London, they kept up a correspondence. It was not until 1840 that Henson is known to have seriously entered on a series of experiments with gliding models, constructional devices, and the making of a type of steam-engine sufficiently light—he states that complete with water and fuel it weighed only about 10 lb.—and with adequate power, to render it efficient for the model flying machine he had designed. 'I have not yet got my model sufficiently advanced to have a fly,' he wrote to Stringfellow early in January 1842, 'but I continue as sanguine as ever as to results.' But despite the assistance afforded by Stringfellow—who was himself engaged at this time on a model light-weight steam-engine—Henson, unsuccessful with his own little engine, gave over the construction to his colleague.

The Aerial Transit Company, 1842.

During 1842 the ambitious scheme based on Henson's invention developed, and two further partners joined the enterprise—Frederick Marriott, also a resident of Chard, who (presumably in his capacity as a journalist) is said to have had some influence in Parliament, and D. E. Columbine, an attorney, who acted as secretary on the formation of the Company, of which he was

[1] See Aeronaut. Classics, No. 5, *Gliding*, by P S. Pilcher, to which is added the Aeronautical work of John Stringfellow, and W. S. Henson, 1910.

[2] The writer has endeavoured in vain to obtain information as to Henson's early or later life.

probably promoter-in-chief.[1] In September a patent was registered for a 'Machine for conveying goods, letters, and passengers from place to place through the air', while early in 1843 Parliamentary powers were sought under an Act of Incorporation for the Aerial Steam Transit Company—the first occasion on which Parliament was asked to interest itself in a subject as to which it has rarely shown either imagination or foresight. A motion for leave to introduce the bill was moved by J. A. Roebuck, at that time Member for Bath, and on March 24, 1843, it was read a first time. Meanwhile the public was invited to subscribe to a Company formed 'to work and prove the Patent', which the 'proposals' —couched in attractive and specious terms common to highly speculative schemes—characterized as without parallel even in an age of gas and steam, and as being 'so simple in principle and yet so perfect in all the ingredients required for complete and permanent success', that the details could not safely be disclosed until fully protected by adequate patents.[2] But despite the highly remunerative inducements offered, little or no financial confidence in the scheme was forthcoming. Considerable public interest was, however, aroused through the medium of the numerous accounts of the 'Ariel' steam carriage published in the press, many of which appeared most inopportunely on April 1st.[3] Generally speaking they were simply descriptive (the technical details obtained from a common source), some editors accepting the invention as a 'wonder of the age', while others denounced it as an impossible and unscientific enterprise. As time passed the latter attitude prevailed and the wits proceeded to ridicule the whole affair in verse as well as prose. The expressions of wonder, for

[1] Marriott was originally a paper-maker, but engaged in various unsuccessful journalistic ventures. About 1848 he went over to America and became editor of the *San Francisco News Letter* (see Sala (G. A.), *Life*, 1896, p. 685, &c.). In 1867–9 his interest in aeronautics revived and he experimented with a steam-driven elongated balloon, fitted with aeroplanes, and subsequently with a flying machine (triplane) having superposed planes. See *Aeronaut. Soc. Reports* for 1869, p. 85, and 1875, p. 76, also the Notes on Marriott's life mentioned in the Bibliography, p. 413. Also Chanute (C.), *Progress of Flying Machines*, New York [1894], p. 130.

[2] Patent No. 9478, 1842, with folding plans. Abridged in Brewer and Alexander, p. 2. The prospectus of the company is printed in Aeronaut. Classics, No. 5, 1910, p. 21.

[3] Plans of the machine—said by F. J. Stringfellow to have been made from the model—were given in most of the papers. Numerous prints were also published showing the 'Ariel' in full flight over London (Fig. 141, frontispiece), the Pyramids, and China. The last-named highly imaginative conception was doubtless inspired by a pamphlet, issued 'By Authority', under the title of 'Full Particulars of the Aerial Steam Carriage . . . to convey Passengers . . . to China, and India in a Few Days' (Fig. 142).

By Authority.

THE

Full Particulars

OF THE

AERIAL

STEAM CARRIAGE,

Which is intended

To Convey Passengers,

TROOPS,

AND

GOVERNMENT DESPATCHES

To China and India,

IN A FEW DAYS.

LONDON:
1843
PRINTED BY T. GOODE, 8, ST. JAMES' WALK,
CLERKENWELL.

Fig. 142.

instance, were made fun of in broadside verses on *The Aërial Ship! or A Flight of Fancy* (printed at Clark's Private Press at Great Totham in April 1843):

> It matters not, I understand, whichever way the wind is,
> They'll waft you in a day or so, right bang into the Indies!
>
> . . . .
>
> Or you may dine in London now, and then, if you're romantic,
> Just call a ship and take a trip right over the Atlantic.

Or the popular view of the Parliamentary Bill was doubtless adequately expressed—though with more regard for wit than sense or metre—in the lines of another journalistic poetaster :

> Though there may be but little doubt
> Of having now the bill thrown out,
> There may be reason perhaps to dread
> The passengers may be thrown out instead.

Bogus Account of an Alleged Flight of the 'Ariel'.

But from a journalistic point of view the best joke against the scheme emanated from Scotland. Early in April there appeared in the *Glasgow Constitutional* a *jeu d'esprit* purporting to describe an 'Experimental Trip on an Aerial Machine' (on the lines of Henson's specification) undertaken by a Professor Geolls. Written with all the verisimilitude of fact it describes the start, the flight over the Clyde, and the disastrous bursting of 'three of the steam-pipes all at the same instant', with the result that the daring aeronaut falls into the river, whence—in the manner of the artist in *Rasselas*—he is rescued by a passing steamer (Fig. 143). A few days later it appeared as a bona fide account in the *Atlas*, and was copied by *The Times*, where the jest was unwittingly enhanced by an editorial note to the effect that in order to avert any misunderstanding, the particulars were given direct 'from the narrative drawn up by Professor Geolls himself'—a lapse on the part of the 'Thunderer' which has led to repeated references to this imaginary trial as an accomplished fact.

Henson's Model Trials, June and July, 1843.

Meanwhile Henson undertook at the Adelaide Gallery a series of experiments with a model machine (actuated by a spring), which it was alleged flew 60 or 80 feet after being started down an inclined plane. Doubts having been expressed as to this achievement, further trials followed with a lighter model and a more powerful steam-engine, later with yet another small steam-engine, and finally resort was had to a new model again actuated by clock-work. At each experiment the model was run down an inclined plane, beyond which wires were placed to catch the model should it fall—which it did do on every occasion.[1] Subsequently Henson moved out to the Hippodrome Racecourse at Bayswater for the sake of more ample space, but his efforts continued to be apparently fruitless. Eventually he suggested to Stringfellow that they should buy out the shares of their colleagues, and make a large model at their own expense. This suggestion having been acted upon

Renewed Experiments with Stringfellow, 1844–6.

[1] There is a long account of these experiments from *The Morning Herald*, Aug. 4, 1843, in the Cuthbert Aeronautical Collection, vol. 4.

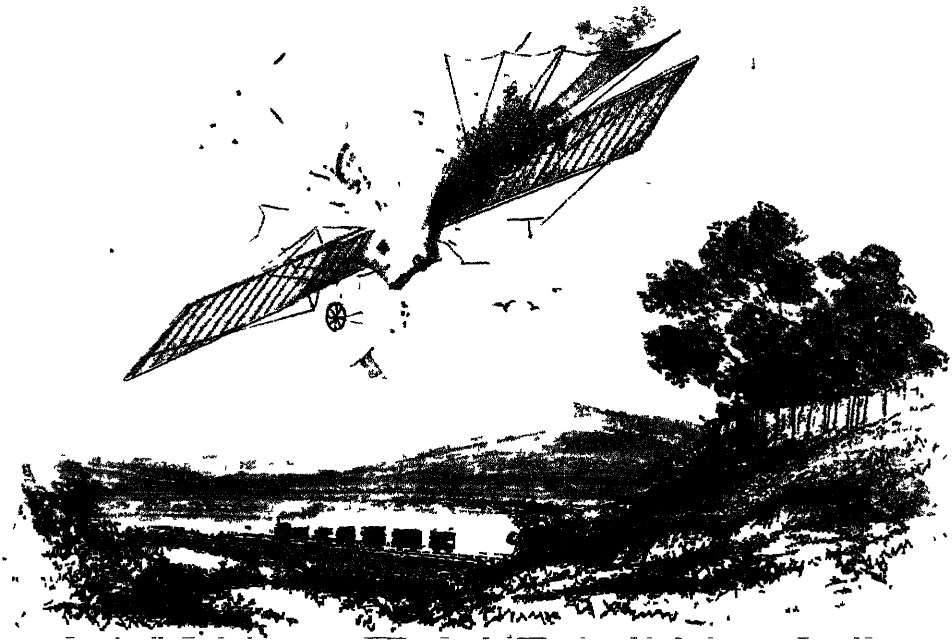


FIG. 143. View of the Imaginary Flight and Destruction of Henson's 'Ariel', 1843

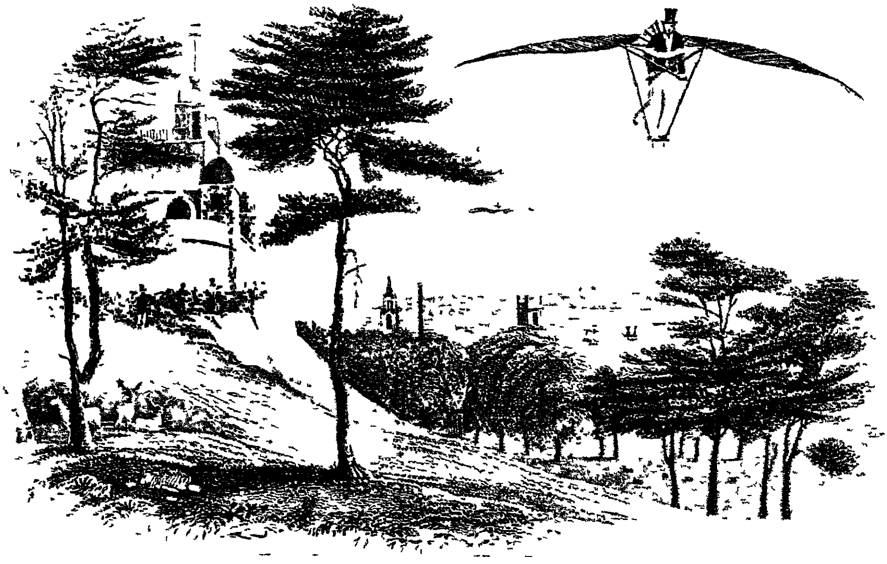


FIG 144 THE AERIAL MAN (Imaginary View in Greenwich Park)

Henson thereupon returned to Chard, and the two inventors entered into a partnership in December 1843, ' to construct a model of an Aerial Machine to be employed in such a manner as the parties . . . shall consider best and most profitable '. Eventually a large engine-driven model was constructed and subjected to many trials (usually carried out in the evening to avoid public ridicule) during 1847 on Bala Down, about two miles from Chard. Success, however, still seemed unattainable, and Henson, discouraged and impoverished, finally gave up the project, crossed to America a year or two later, and disappeared ' in the wilds of Texas from the ken of aeronautical science '.

Henson goes to America.

His Merits.

So little is known of Henson that it is difficult even to hazard an opinion of his character, and hardly less difficult to estimate his ability as an engineer. Probably he was too readily led away by the prospects of success, and his project—doubtless through the company-promoting character of Columbine, from whom it is not without significance that Henson parted—became so inflated, that the possibility of attempting to carry it out on sound mechanical lines was thereby rendered the more difficult, and the project finally discredited. This much at least may be fairly said, that though it is true Henson's idea of a flying machine outran a sound appreciation of the scientific principles, let alone the difficulties involved; though such experiments as he made were not less evidently inadequate to test the general features of his design, and though his failure to construct a steam-engine of light weight shows him to have been in that respect inferior in inventive engineering skill to Stringfellow, it is not the less true that Henson conceived the idea of a ' heavier-than-air ' machine (designed for the transportation of men and goods) on lines, which, for the first time, embodied the essential principles of the aeroplane, and by means of which success was ultimately achieved. And he did more than merely conceive it—he set to work to design and (though in a more limited sense) to construct it, and the ultimate discredit which his scheme suffered should not be allowed to rob him of his rightful place as a notable pioneer in the development of mechanical flight.

John Stringfellow (1799–1883).

The life, work, and character of John Stringfellow is better known than that of his colleague.[1] He was born at Attercliffe,

[1] The names of Henson and Stringfellow are notable omissions from the *D. N. B.* For the particulars here given the writer is mainly indebted to F. J. Stringfellow's *Few Remarks on Screw-Propelled Aero-plane Machines*, Chard [1892], and to the account of John Stringfellow and W. S. Henson, in Aeronaut. Classics, No. 5, 1910. Also to the memoir of the former in *Aeronaut. Soc. Reports* for 1883–4 (p. 55).

Sheffield, on December 6, 1799, and was apprenticed in Nottingham at an early age to the lace trade. His mechanical aptitude—which he inherited from his father and which he passed on to his sons—gained for him a considerable reputation as bobbin and carriage manufacturer, and about 1820 he removed to Chard where, within a few years, he set up a lace factory on his own account. His connexion and joint work with Henson have already been mentioned, though it may be added that at an earlier date he had considered, but abandoned, the idea of winged flight. It is evident that after the separation from Columbine and Marriott, Stringfellow played the more important part in the trials which followed with the large steam-driven model, at least as far as the motive power was concerned, and it is notable that on one occasion he particularly refers to the fact that 'the steam engine was the best part' of the machine. Moreover, he was not discouraged even when Henson retired, for he set to work on another large model which he completed in 1848, and with which, as being the first model engine-driven aeroplane to fly, Stringfellow's name must be for ever associated (Fig. 147). In 1849 he travelled with his son to America, and on his return to this country gave up for the time his aeronautical work. But his unobtrusive enthusiasm and his energies were revived in 1866 on the foundation of the Aeronautical Society of Great Britain, and the subsequent reading of Wenham's paper on 'Aërial Locomotion' stimulated his ideas, with the result that he resumed his interrupted work. At Wenham's suggestion he constructed—on the 'three-decker' lines foreshadowed by Cayley—a model machine with triple superposed planes, to which he fitted a light steam-engine of less than one horse-power (Fig. 148). It was duly exhibited at the first Aeronautical Exhibition at the Crystal Palace in 1868, together with a separate engine of one horse-power (inclusive weight, 16 lb.), for which Stringfellow was awarded the prize of £100 for 'the lightest steam engine in proportion to its power'.[1]

His Work with Henson.

His First Successful Model, 1848.

His Model Triplane, 1868.

Having become a member of the Aeronautical Society in 1868, he continued his work for some time longer, erecting a 70 foot shed for experimental work with the £100 awarded him.[2] But advancing age and failing eye-sight prevented further notable achievements before his death, which, however, did not occur until December 13,

His Death, 1883.

[1] The specification of the separate engine is given in *Aeronaut. Soc. Report* for 1868 (Exhib. Report, p. 6).

[2] F. Marriott, then of San Francisco, Stringfellow's partner of nearly thirty years earlier, also joined the Aeronautical Society in 1871. See note 1 on p. 356.

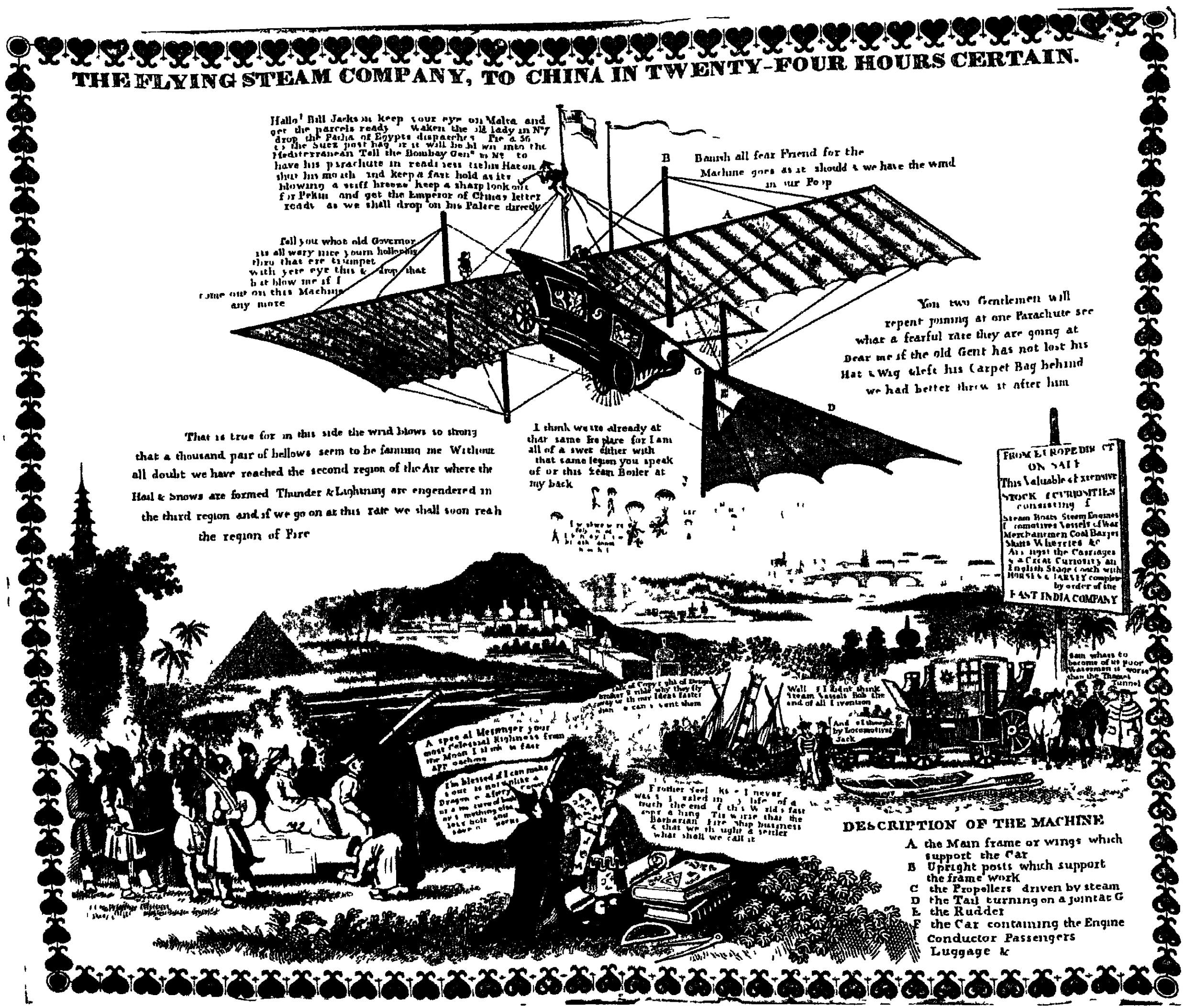


Fig. 145 SOUVENIR LINEN HANDKERCHIEF OF HENSON'S 'ARIEL', 1843.

1883. Time has amply justified the restrained judgment passed by Brearey—that the name of Stringfellow will find a place on the roll of famous aeronautical pioneers, because he not only believed that 'aerial navigation was capable of accomplishment', but gave 'much time and means to its elucidation', on lines (be it added) which are now proved to have been in the direct path of true progress.

Technical Points in Henson and Stringfellow's Work.

Dealing briefly with Henson and Stringfellow's aeronautical work from the technical side—it has been justly said that Henson's adoption of the Fink truss for his wing construction as early as 1842 must be regarded as extraordinary, while his design in general contained 'all the essential elements of the modern aeroplane wing, such as front and rear spars, and main and secondary ribs'.[1]

Specification of the 'Ariel'.

Bearing in mind that Henson's 'Ariel' was never actually constructed, the features of the design—as shown in the plan—were as follows.[2] A main frame, flat and rigid throughout its length of about 150 feet, with a width of 30 feet, was to be constructed of extreme lightness, and covered with linen or silk to serve as a supporting surface or plane. Beneath the middle of the frame braced by diagonal wires of 'oval section' passing over three sets of king-posts, was a car containing a two-cylinder engine of 25–30 horse-power, driving two propellers (each with six vanes, or blades, 10 feet in length) placed behind the main plane, with their axes on a level with its trailing edge. Attached to the centre of the frame was a web-shaped tail (thus affording a total supporting surface of 4,500 square feet), and beneath the tail a small vertical rudder, both controlled by cords. A small 'web' extending across the main frame above the car was designed to diminish lateral oscillation.

Proposed Method of Launching.

It was generally believed at the time that Henson's chief merit lay in his proposal to overcome the inertia at the start of flight, by running the machine (on wheels provided beneath the car) rapidly down an incline, thus acquiring the momentum necessary to obtain sufficient air-pressure to sustain the supporting surface.[3]

[1] Pawlowski (F. W.) 'The Evolution of Aeroplane Wing-Trussing,' in *Air*, vol. 1, No. 4, 1917, p. 103. Cf. Chatley (H.), *The Problem of Flight*, 1907, ch. 4, The Aeroplane, where it is said that 'the aeroplane as now known was the invention of Henson'.

[2] The writer has been unable to find confirmation of Wenham's statement (*Aeronaut. Soc., Second Report*, p. 49) 'that Henson's machine was actually constructed'. The nearest approach to any such statement is a note on a photo of the large engraving of the 'Ariel', to the effect that the contractors for the machine were Messrs. Adams & Fox, of Old Ford.

[3] One imaginative print of Henson's 'Ariel' depicts the Transit Co's Station 'in the

In order to diminish the resistance during this descent a remarkable provision was made for reefing the covering of the wings, which were to be ' rapidly spread ' before the machine reached the bottom. The total weight of the machine—including 600 lb. for engine and boiler—was to be 3,000 lb., a weight which was believed to be ' considerably less per square foot than that of many birds '.

Lack of Aero-dynamic Data.

But it is evident—indeed from the undeveloped state of aerodynamic science at that date it is certain, that Henson had considerable doubts as to the resistance his machine would have to overcome. ' Mechanical science ', so runs a paragraph in the pamphlet before mentioned, ' is notoriously defective in all that relates to the impact of solids and fluids ', experiments heretofore having concerned only head resistance to the neglect of perpendicular resistance, with the result that there was no data then available ' on which the smallest reliance can be placed '—an admission which is not less startling than it was doubtless true. Indeed, Henson's failure to achieve any success with his model, having a surface of 40 feet and weighing 14 lb.—whether driven with his small steam-engine or the spring mechanism—is sufficient evidence that he had much to learn before a full-scale machine of his design could have been constructed with any reasonable prospect of success in flight.

Joint Model Experiments in 1844.

For that reason the subsequent experiments made by Henson and Stringfellow at Chard in 1844, are of more practical interest than the project of the ' Ariel '. They began with a small model operated with a spring, but it was not until more than two years later that they commenced a series of open-air trials with a model, the wings of which had a span of 20 feet, $3\frac{1}{2}$ feet chord, with a sustaining surface of about 80 feet in all. As an authoritative and detailed record of the earliest known experiments of this character, F. J. Stringfellow's account of his father's work may be quoted at length.[1]

'. . . The making of this model required great consideration ; various supports for the wings were tried, so as to combine lightness with firmness, strength and rigidity. The planes were staid from three sets of fish shaped masts, and rigged square and firm by flat steel rigging. The engine and boiler were put in the car

Plains of Hindostan ', with a ' despatch-tower ' (having a passenger lift, in the manner of Kipling's ' With the Night Mail '), and inclined launching ways. See Patent Office Collection, vol. 6, fo. 39.

[1] Stringfellow (F. J.), *A Few Remarks on Screw-Propelled Aero-plane Machines*, 1892, p. 4.

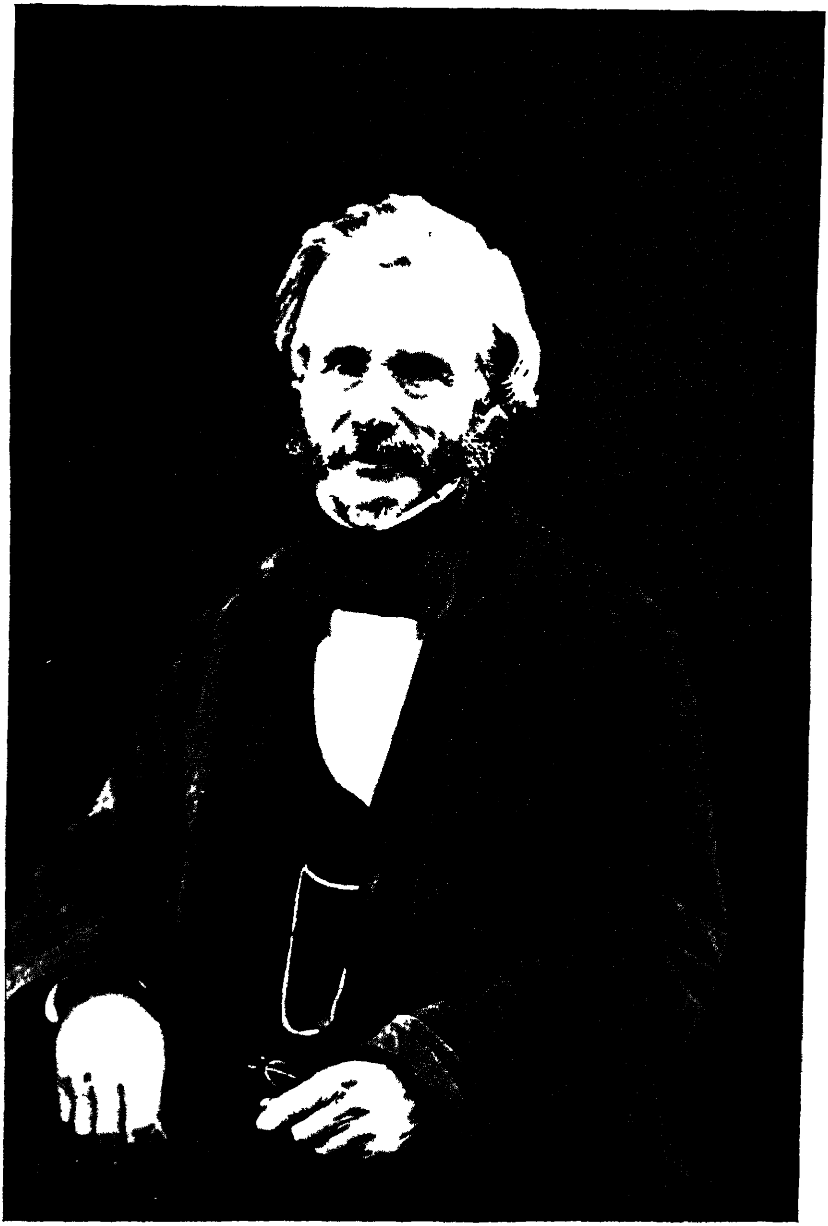


FIG 146. JOHN STRINGFELLOW.

to drive two screw propellers, right and left handed, three feet in diameter, with four blades each, occupying three-quarters of the area of the circumference, set at an angle of sixty degrees. A considerable time was spent in perfecting the motive power. Compressed air was tried and abandoned. Tappets, cams, and eccentrics were all tried, to work the slide valve, to obtain the best results. The piston rod of engine passed through both ends of the cylinder, and with long connecting rods worked direct on the crank of the propellers. From memorandum of experiments still preserved, the following is a copy of one. June 27th, 1845, water 50 oz., spirit 10 oz., lamp lit 8.45, gauge moves 8.46, engine started 8.48 (100 lb. pressure), engine stopped 8.57, worked 9 minutes, 2,288 revolutions, average 254 per minute. No priming, 40 oz. water consumed, propulsion (thrust of propellers), 5 lbs. 4½ oz. at commencement, steady, 4 lbs. ½ oz., 57 revolutions to 1 oz. water, steam cut off one-third from beginning. The diameter of cylinder of engine was one-and-a-half inch, length of stroke three inches. . . . In the meantime, an engine was also made for the smaller model, and a wing action tried, but with poor results. The time was mostly devoted to the larger model, and in 1847 a tent was erected on Bala Down, about two miles from Chard, and the model taken up one night by workmen employed by my father. The experiments were not so favourable as was expected. The machine could not support itself for any distance, but when launched off, gradually descended. Although the power and surface should have been ample, indeed, according to latest calculations, the thrust should have carried more than three times the weight, for there was a thrust of five pounds from the propellers, and a surface of over 70 square feet to sustain under 30 lbs., but necessary speed was lacking.' [1]

From John Stringfellow himself we learn that the framework proved ' altogether too weak ' ; that (as already mentioned) the steam-engine was the best part, and that failure was not due to want of power or sustaining surface, but rather to a ' proper adaptation of the means to the end of the various parts '. It may be added that although the relation between surface and weight (the engine, fuel, and water amounted to about 28 lb.) was arrived at as a tentative solution, Stringfellow did endeavour—according to Brearey, who assisted with the later experiments in 1868—to test ' the resistance of various angles against the air at high speeds ', by means of an apparatus he took with him when travelling on express trains.

[1] F. J. Stringfellow's pamphlet (op. cit., p. 5) contains a small photograph of a ' larger model ' tried in 1847, made from an engraved ' facsimile of the model '. A comparison with Fig. 141 (frontispiece to the present work) reveals the fact that the engraving of 1843 here reproduced is the one referred to in the pamphlet. See note 1 on the next page.

Stringfellow's First Flying Model, 1848.

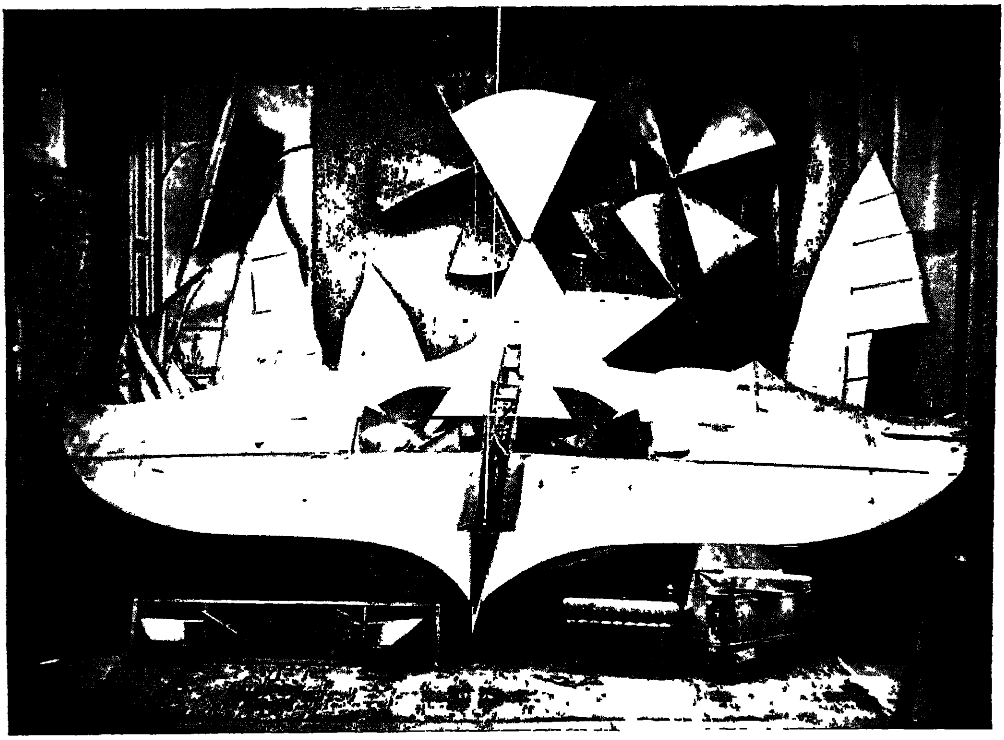
Of greater, indeed of historic interest, was the model which Stringfellow designed after Henson left him, and the construction of which he completed early in 1848.[1]

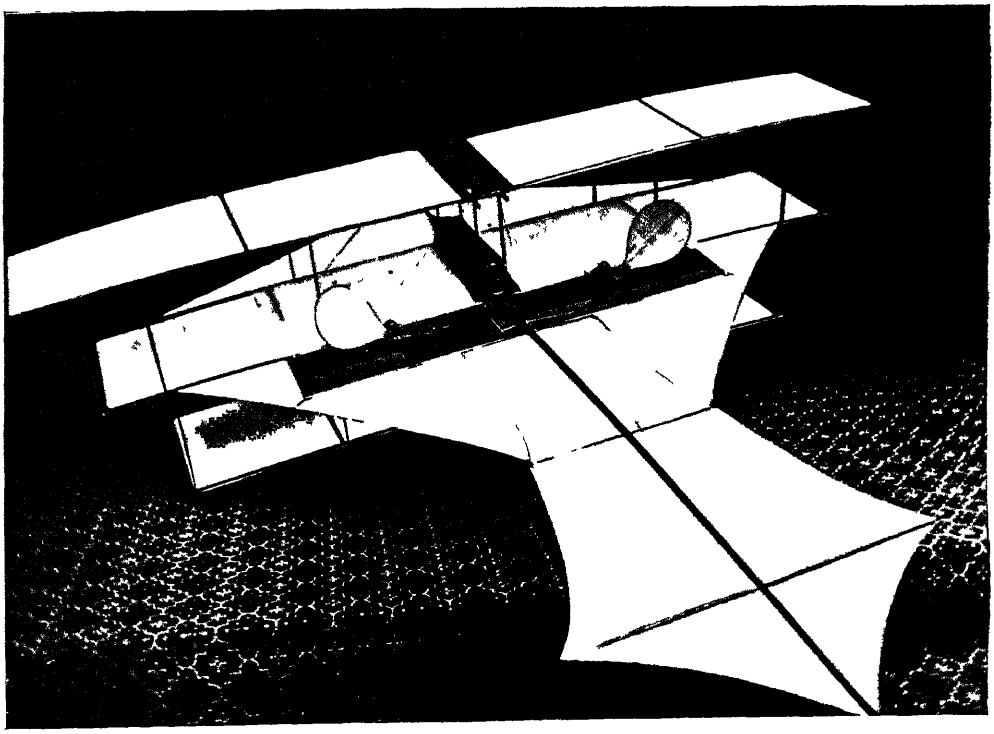
'The aero-planes of this model', to quote again from F. J. Stringfellow's 'Remarks', 'were about 10 ft. from tip to tip, and 2 ft. at the widest part, tapering to a point, slightly curved on the under surface, rigid in front, feathered at the back. Length of tail three ft. six ins., width in widest part 22 ins. surface in wings and tail about 14 ft. Right and left screw propellers, 16 in. diameter, with four blades, occupying three-quarters of the area of the circumference, set at an angle of 60 degrees. The cylinder of engine three-quarter in. diameter, length of stroke two in., bevel gear on crank shaft giving three revolutions of propellers to one stroke of engine. The weight of the entire model with water and fuel, was under nine pounds. The inclined wire for starting the machine from, occupied less than half the length of the room, and left space at the end for the machine to clear the floor. In the first experiment the tail was set at too high an angle, and the machine rose too rapidly on leaving the wire. After going a few yards, it slid back as if coming down an inclined plane at such an angle that the point of the tail struck the ground and was broken. The tail was repaired, and set at a less angle. The steam was again got up, and the machine started down the wire, and upon reaching the point of self-detachment, it gradually rose until it reached the farther end of the room, striking a hole in the canvass placed to stop it.[2] In experiments the machine flew well, when rising as much as one in seven. The late J. Riste, Esq., lace manufacturer, Northcote Spicer, Esq., J. Toms, Esq., and others, witnessed experiments. Mr. Marriatt, [*sic*], late of the San Francisco News Letter, brought down from London Mr. Ellis, the then lessee of Cremorne Gardens, Mr. Partridge, and Lieutenant Gale, the aeronaut, to witness experiments. Mr. Ellis offered to construct a covered way at Cremorne for experiments. Mr. Stringfellow repaired to Cremorne, but not much better accommodations than he had at home were provided, owing to unfulfilled engagement as to room. Mr. Stringfellow was preparing for departure, when a party of gentlemen unconnected with the Gardens, begged to see an experiment, and finding them able to appreciate his endeavours, he got up steam, and started the model down the wire. When it arrived at the spot where it should leave the wire, it appeared to meet with some obstruction, and threatened to come to the ground, but it soon recovered itself, and darted off in as fair a flight as it was possible to make, to a distance of about 40 yards, where it was stopped by the canvass.'[3]

[1] In the *Third Report of the Aeronaut. Soc.*, 1868 (p. 41), Stringfellow is said to have stated that his model 'really did fly in 1847', but it is not clear to which model he referred.

[2] The model was first tried early in June 1848 in a long room (22 yards long by 12 feet high) in a disused lace factory at Chard.

[3] Op. cit., p. 6.





FIGS 147 and 148 JOHN STRINGFELLOW'S MODEL AEROPLANES

Above The Monoplane, showing Engine, Boiler, Propellers &c.
Below The Triplane exhibited at the Crystal Palace, 1868.

This is generally held to be the first public occasion on which an engine-driven model aeroplane was successfully flown.[1] The engine of this famous miniature aeroplane of 1848, after being in use to drive a small lace-machine at Tiverton, was rescued from destruction and is now preserved at the Science Museum, South Kensington.

His Triplane Model, 1868.

Though the 1848 model is of unique interest, Stringfellow's triplane model (which was inspired in some measure by F. H. Wenham's paper on 'Aerial Locomotion', 1866), exhibited in the Crystal Palace at the first exhibition held by the Aeronautical Society in 1868, was a remarkable machine, and embodied the earliest attempt to adapt 'superposed aeroplanes to a steam flying machine'. It had a supporting surface of 28 square feet, and weighed (with engine, boiler, fuel, and water) under 12 lb. Though no free flight was allowed (owing, it is said, to danger from fire), the model was reported to lift from the wire by which it was suspended and along which it ran.[2] Some months afterwards Stringfellow tried it (in the presence of F. W. Brearey) in a field at Chard, but without further success.

The story of Henson and Stringfellow extending over nearly fifty years may be said to bring to a close an era in the evolution of mechanical flight. There were, of course, during that period many other schemes and projects, though none of comparable importance or interest. For example J. Luntley published an anonymous treatise in 1847 entitled *Aerial Navigation,* in which he described a machine with wings and tail like a bird, the former actuated 'by a gas engine, resembling a pair of bellows', though the inventor admits—and the admission is a rare one in aeronautical annals—that 'the consideration of danger' discouraged him from carrying out his scheme.[3] A similar idea occurred to Dr. W. Smyth in 1867, and is set forth in an interesting paper on 'Experiments

[1] W. H. Phillips in 1842 'succeeded in raising into the air an apparatus weighing in the aggregate 2 lb. by means of revolving fans inclined about 20 degrees from the horizontal' (see *Aeronaut. Soc. Report,* 1868, p. 10 of the Exhibition Report). But the model was in principle a helicopter and therefore incapable of horizontal flight. For W. H. Phillips's ideas on mechanical flight see Appendix II, p. 380.

[2] This triplane model and the light engine of 1868 were subsequently purchased by Prof. S. P. Langley, and are preserved in the Smithsonian Museum at Washington, D.C. See also Ch. XII, p. 283, *ante.*

[3] [Luntley (J)], *Aerial Navigation, containing a Description of a Proposed Flying Machine,* by Daedalus Britannicus, 1847; *Aeronaut. Soc. Report* for 1868, p. 49. Cf. Ch. XIII, p. 315, *ante.*

practically demonstrating the Laws by which Birds fly, and their application to an Aerial Machine', read before the Aeronautical Society.[1] In 1856 Viscount Carlingford took out a patent for an 'Aerial chariot, or apparatus for navigating the air', which was to take the form of a boat, with 'two wings, slightly concave, fixed to its sides'. Propulsion was provided by means of a 'tractor' screw—known as the Carlingford screw—the blades of which were so designed that 'their edges became more direct towards the centre'. An apparatus is described for suspending the machine by ropes between two poles, on being released from which it would fall upon the air with great velocity, which first impetus (it is said) 'is easily sustained and increased by turning the aerial screw'. The final paragraph—'When a certain altitude is attained the chariot may go several miles, perhaps fifty or sixty, as it were upon an inclined plane of air'—recalls the confidence of the would-be designers of navigable balloons in the early days of the invention.[2]

Carlingford's 'Aerial Chariot', 1856.

Nevertheless, sound progress was being made, and one feature at least (as Professor Raleigh has truly said) of the nineteenth-century contribution to the science of flight was that 'it got hold of the right questions', and (it may be added) strove to demolish the old fallacies. Amongst many others, for instance William Crofton Moat, a member of the Royal College of Surgeons (who claimed to have studied aerial locomotion from childhood), fully grasped the fact that flight was a 'purely engineering question', and that inasmuch as the resistance of the air to a flat surface increases with the square of the velocity of that surface, mechanical flight was 'an affair of certainty and ease'. In 1843 he patented a machine for 'Aërial Locomotion', in which four 'flappers' were to be worked by manual power, while in 1853 he sought to raise support for the construction of 'Steam Flying Conveyances', by a series of addresses at Crosby Hall, and in connexion therewith issued a small leaflet containing some particulars of his 'Flying Machine'.[3] It consisted in the main of two huge wheels fitted with

Moat's Steam Flying Machine, 1853.

[1] *Aeronaut Soc. Report* for 1867, p. 32. See also Brewer and Alexander, p. 40 (Patent, no 1392)

[2] Brewer and Alexander, p. 17 (Patent, no. 2993, 1856). In 1863 Lord Carlingford (in controverting aeronautical claims attributed to Nadar) stated in the Irish Journals 'that on the last trial my aerial chariot (that weighing 17 stone) arose on the air without any assistance but that of the wind'. (*The Giant Balloon*, compiled by F. Silas, 1863, p. 59.)

[3] Brewer and Alexander, p. 5 (Patent, no. 9856, 1843).

twenty-four planes (designed to feather as in the paddle-wheel of a steamer), which when driven at a velocity of 400 miles an hour would give a lift 'equal on the whole to 128 tons on half the planes'. Moat asserted with old-time assurance that the machine he proposed to construct—which he calmly stated would 'weigh less than twenty tons'—would be perfectly manageable and safe, and capable of travelling at such high speed 'as to leave no part of the world more than a day's journey from home'. Incidentally he claimed that the first effect of the use of such machines would be to stop war, and the second to unite friends. But in this case again the impracticable design, though based on large principles which were sound, was purely theoretical and bore no relation to any model tests or experiments.

It is needless to multiply these typical examples—the files of the Patent Office, the pages of the *Mechanics' Magazine*, and elsewhere, bear eloquent, if silent and for the most part forgotten witness, to an immense, albeit for the most part fruitless expenditure of thought, time, and money, on the part of countless enthusiasts and advocates of a great idea. As the century drew nearer to its close the pages of the Aeronautical Society's Reports reveal the fact—as recorded in a previous chapter—that the more serious and enlightened advocates of aviation were at this period turning their attention more and more to practical experiments (if only on model scale), and striving to establish the basic principles of aerodynamics with the support of scientific data, leaving the mechanical features of the flying machine of the future to evolve in due course.[1]

Such was the general position in the development of mechanical flight at the end of the period with which this book deals. There had only to follow the experiments of the great 'gliding' pioneers, directed towards achieving stability and control, together with the introduction of the internal-combustion engine to supply the propelling force, and within a few short years the age-long aspiration of man had become, in its two-fold sense, an accomplished and astounding fact.

[1] See Appendix II for a list of the more important papers in the Society's Reports, a study of which will in itself afford a comprehensive view of the trend of ideas and endeavours between 1866–93. See also Ch. XII, p. 273, *et seq.*

NOTE ON KITES AND KITE-FLYING

As bearing, though in an inverse sense, on certain aerodynamic factors involved in the pressure of air on plane surfaces moving in the atmosphere, the principle of the kite and the part—albeit comparatively small—which it has played in the elucidation of those factors, calls for a brief description. That principle demonstrates the upward thrust of the wind, by reason of which the kite—a light framework of triangular shape covered with paper and held or restrained by a string—mounts in the air. Or if, regarding the kite as essentially a toy, we imagine a small boy striving on a calm day to fly it by running with the string, then in so far (though probably not far) as it rises and moves through the air, it illustrates conversely the principle of the power-driven aeroplane.

ient. gin of Kite.

It cannot be doubted that the kite, though of uncertain, is nevertheless of very ancient, origin. As an invention in the fourth century B.C. it has been attributed to Archytas of Tarentum—a name more often quoted in connexion with the story of the mechanical dove, which may, indeed, have flown on the kite principle. Though in widespread use as a pastime among the Chinese, Japanese, Maoris, and other peoples, its origin is usually ascribed to religion.[1] In England the actual word, in its main present-day sense of a toy—as apart from the original and much earlier ornithological use—does not date beyond the middle of the seventeenth century, at which period the kite was in common use for the purpose of letting off fire-works. In his *Mysteries of Nature and Art*, 1634, John Bate describes (in the section on Fier-Works) the making of a kite for this purpose, though it will be noticed he does not use the word. ' You must take a piece of Linnen Cloth of a yard or more in length; it must be cut after the form of a pane of Glass; fasten two light sticks cross the same, to make it stand at breadth; then smear it over with Linseed Oyl, and liquid Varnish tempered together, or else wet it with Oyl of Peter; and unto the longest corner fasten a Match prepared with Saltpeter water . . . upon which you may

[1] The so-called Japanese ' May-Carp '—a fish-formed kite similar to those used on aerodromes in recent years—is commonly seen floating from the house-tops in Japan during the May festival. Man-lifting kites are said to have been used in Japan some centuries ago.

fasten divers Crackers, or Saucissons; betwixt every of which binde a knot of Paper-shavings, which will make it flie the better . . . then tie a small Rope of length sufficient to raise it unto what heighth you shall desire, and to guide it withall; then fire the Match, & raise it against the wind in an open field, and as the

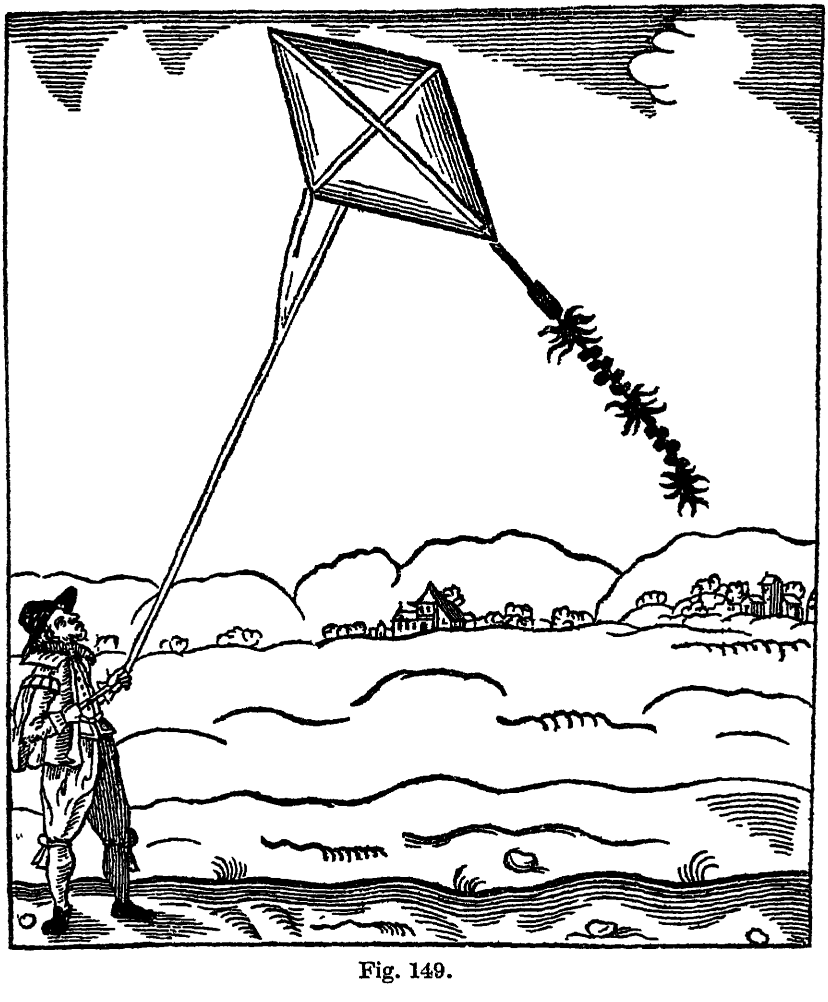


Fig. 149.

Match burneth, it will fire the Crackers, and Saucissons, which will give divers blows in the Ayer.'[1] The kite shown in the woodcut is of the simple triangular or diamond-shaped type, with a tail to afford stability, as commonly used down to the latter half of the

[1] Bate (J.), *The Mysteries of Nature and Art*, 1654 (Of Fier-Works), p. 100. The first edition appeared in 1634. By a strange coincidence the device following that above quoted is, 'How to make Balloons', i. e. a balloon-shaped bag of canvas filled with combustibles and fired from a mortar.

nineteenth century. Curiously enough it is as a fire-work that Butler—in ridiculing the prognostications adduced from the appearance of comets—introduces the word in *Hudibras*, 1664, when he describes how:

> It happen'd as a boy, one night,
> Did fly his tarcel * of a kite; * [a young hawk]
>
> . . . . . .
>
> His train was six yards long, milk-white,
> At th' end of which, there hung a light,
> Inclosed in lanthorn made of paper. . . .

which Sidrophel (personifying the astrologer, William Lilly) is absurdly made to mistake for a comet, and from its sudden fall—on the breaking of the string—to adduce a 'horrible and fearful portent'.[1]

Kite-flying for Scientific Purposes.

But to return from this literary digression. It is probable the kite was first used for scientific purposes in 1749 by Alexander Wilson, Professor of Astronomy at Glasgow University, while in 1752 Benjamin Franklin made his well-known and dangerous experiment of collecting atmospheric electricity through the medium of a kite covered with silk, and fitted at the top with a metal point.[2] It was, not, however, until the last quarter of the nineteenth century that any systematic use was made of kites for scientific purposes.[3]

Pocock's 'Char-volant', 1826.

The first notable endeavour to apply the principle to a practical purpose was made about 1826 by George Pocock, a schoolmaster of Bristol. Having as a lad experienced in his kite-flying escapades that his toy would draw along a stone tied to the end of its string, he became ambitious to exploit its powers, and later 'conceived an entirely new plan' of tying a second kite to the string of the first—an invention of which he recalls that he 'became as proud as Caesar when he passed the Rubicon, or Alexander when he tamed the wild Bucephalus'. Twenty-seven years later he experimented with his pupils on 'the breezy eminences of Clifton', and found that by attaching several kites, one beneath another, they could

[1] Butler (S.), *Hudibras*, 1664, Part 2, Canto III, line 413. This quotation is given in the *Oxford Dictionary* as the first illustration of the use in this sense of the word kite.

[2] See McAdie (A.), *Principles of Aerography* [1917], p. 8, for a reference to Wilson.

[3] *Ency. Brit.*, 11th edition, 1911, vol. xv (Kites), p. 839. Wilson claimed in a paper read before the Royal Society in April 1778, that he used kites (let up on wire in lieu of cord) for electrical experiments at Glasgow long before Franklin. With four or five paper kites strung one above another he raised instruments to 3,000 feet (*Roy. Soc.* [*MS.*] *Letters and Papers*, vol. lxi, 1778).

Fig 150 POCOCK'S CHAR-VOLANT OR KITE CARRIAGE
1827

be elevated above the clouds. Thence arose new ideas—a board was attached to the cord and drawn along rapidly like a sledge, and next the 'family car' with a full load was dragged easily over the turf. After the lapse of several years Pocock further developed this 'aeropleustic art'—a pedantic term invented and used by him alone—by constructing a specially built four-wheeled carriage, or 'char-volant' as he termed it, which was used in conjunction with two or more large kites (one above another) of the 'common circular-headed shape', made to fold up, and controlled as to angle and obliquity by four lines.[1] He demonstrated that the power of a kite 12 feet high with a spread of 49 square feet, in a wind of twenty miles per hour, was as much as a man could stand against, and that two large kites (with a surface of 100 square feet) sent up in a gentle breeze had a draught power of 3 cwt., or 9 cwt. in a brisk gale. On January 8, 1827, Pocock claimed to have covered several miles between Bristol and Marlborough at twenty miles per hour—a speed which he remarks need not be thought dangerous—and that on this occasion the London mail-coach was easily overtaken. Moreover, he proposed to apply kites to marine purposes—for towing boats or life-saving from shipwrecks on a lea shore—and he suggested their military use for elevating a man in reconnaissances and signalling.[2]

But Pocock's novel application of the kite was not a practicable scheme, and in this country with its uncertain winds, the insuperable drawbacks must have been revealed after a few trials.[3] Moreover, save for an earlier suggestion made in 1823 by Capt. G. C. Dansey for the use of a 'storm-kite' in case of shipwreck, and a minor improvement on the same, Pocock knew of 'no other inventions or expedients, by means of Kites, mentioned in any work whatever'—an observation which (for what it is worth, and excepting its use in pyrotechnics) the present writer can confirm. Many years later it was indeed said that F. H. Wenham, in his

[1] See *Abridgments of Specifications relating to Aeronautics* [by W. H. Walenn], 1869, Patent no. 5420, Oct. 18, 1826, granted to James Viney and George Pocock.

[2] Pocock (G.), *The Aeropleustic Art, or Navigation in the Air by the use of Kites or Buoyant Sails* [1827], (Fig. 150). Pocock asserted that his kites would raise a man 'in the air to a vast height', and proudly claimed for his daughter the honour of being 'the *first Aeropleust*'. The *Oxford Dictionary* gives no other use of the word 'aeropleustic', but by misprinting 'of' for 'or', and in omitting the words after 'Air', the meaning attributed (viz. 'of or pertaining to navigation in the air; aeronautical') is not strictly correct. An anonymous issue of the book, with new plates, appeared in 1851

[3] Pocock expressly provided against a calm by attaching to the 'char-volant' a low-wheeled platform on which a pony was to be carried!

paper on 'Aerial Locomotion'—written in 1859—was the first to call attention to 'the fact that the kite as a means of obtaining [in certain cases] unlimited lifting and tractive power had been unduly neglected'. But though Wenham's interest in the subject had a greater significance, it cannot be said that his suggestion as to the military use of kites in lieu of balloons, was anything more than a revival of Pocock's own scheme.[1] In a similar way E. J. Cordner, an Irish Catholic priest, reinvented the use of the kite for life-saving, though he used a different type—hexagonal disks of fabric (stretched upon three sticks) flown above each other on the same line. The scheme was tested by transporting a number of people from a rock off the Irish coast by means of a basket suspended from and hauled along the kite-line, as in the modern rocket apparatus. But neither this nor other similar devices ever came into general use, despite the encouragement held out at the Aeronautical Exhibition of 1868, when the Shipwrecked Mariners' Society offered a prize 'for the best form of Kite . . . for establishing a communication from a wreck on shore'.

A nearer approach to experiments of an aeronautical character was made by Joseph Simmons in 1876, when he was drawn up into the air—it is said to a height of 600 feet or more—by means of two superposed kites, and then adjusting his weight by means of guy lines glided down to earth.[2] But the uncertainty of the wind prevented the development of kites for any useful purpose, though they have been used to a considerable extent in later times for meteorological objects. It was not, however, until about 1892, when Lawrence Hargrave, of Sydney, invented the so-called 'box' or 'cellular kite', for experimental work on sustaining surfaces or planes (which followed his earlier experiments with model flying-machines), that important aerodynamic data was obtained from their use.[3] Incidentally, it may be said that the 'box-kite' is the type now in common use as a toy—the purpose it has most consistently and successfully served throughout its history.

[1] Chanute (O.), *Progress in Flying Machines*, Chicago, 1894, pp. 174–201, &c., where there is a full account of kite-flying devices invented between about 1860 and 1890.

[2] Op. cit., p. 177. Simmons filed a patent for his invention (no 2428, 1875) as 'Improved Means and Apparatus for Conveying or carrying Human Beings or Objects into Mid Air'. In 1894 Major B. F. S. Baden-Powell experimented with four or five superposed kites capable of lifting a man to a height of 100 ft. (*Aeronaut. Journal*, vol. 3, 1899, p. 5).

[3] Op. cit., p. 229. Also Means, 1896, which contains several articles on flying 'Hargrave' and other kites.

APPENDIX I

AERONAUTICAL CHRONOLOGY IN GREAT BRITAIN

(With some Dates of Foreign Events in italic)

B. C.	850	Legend of Bladud, the Flying King of Britain.
A. D.	1040	Oliver of Malmesbury's attempt to fly.
	1250	Roger Bacon's speculations on flight.
	1490–1514	*Leonardo da Vinci's writings on the flight of birds, mechanical flight, and the parachute.*
	1507	John Damian (Abbot of Tungland) attempts to fly from Stirling Castle.
ca.	1590	Bp. Godwin's 'flying' romance, 'The Man in the Moone' (published 1638).
	1595	*Veranzio's 'Machinae Novae', published at Venice.*
	1627	Francis Bacon's observations on flight.
	1628	*Flayder's 'De Arte Volandi', published at Tübingen.*
	1640	Bp. Wilkins's 'Discourse concerning Flying', &c.
	1655	Hooke's experiments with model flying machines.
	1663	The Marquis of Worcester's 'Century of Inventions'.
	1665	Joseph Glanvill's prophecies as to flight.
	1670	*Lana's Flying Boat (described in the 'Prodromo').*
	1679	Hooke's examination of Lana and Besnier.
	1680	*Borelli's 'De Motu Animalium' published at Rome.*
	1692	Sir Wm. Temple ridicules ideas of flight.
	1709	*Gusmão's alleged ascent in his 'Passarola' at Lisbon.*
	1742	*Marquis de Bacqueville's attempted flight with wings across the Seine at Paris.*
	1751	James Sadler, the first English aeronaut, born at Oxford.
	1751	Paltock's flying romance, 'Peter Wilkins'.
	1755	*Galien's 'L'Art de Naviger dans les Airs', published at Avignon.*
	1759	Dr. Johnson's 'Dissertation on the Art of Flying' (in 'Rasselas').
	1766	Cavendish determines the specific gravity of hydrogen.
	1766	Black suggests experiments with a bladder inflated with hydrogen.
	1768	*Paucton's treatise on the helicopter (Théorie de la vis d'Archimède).*
	1771–81	*Blanchard's application of a parachute to his 'Vaisseau-Volant', or ornithopter flying-machine.*
	1773	Cayley born at Brompton, Yorks.
	1774	Priestley's 'Experiments on Different Kinds of Air'.

	1781	*Meerwein's experiments with a winged flying-machine at Giessen.*
	1781	Cavallo's experiments with hydrogen and soap-bubbles.
June 5	1783	*First public experiment with a hot-air balloon by the Montgolfiers at Annonay.* (See note 1, p. 101).
Aug. 27	1783	*First experimental ' inflammable-air ' balloon released from the Champ de Mars, Paris.*
Sept. 19	1783	*Montgolfier's experimental hot-air balloon (with living animals) at Versailles.*
Nov. 21	1783	*First free ascent of a balloon with aeronauts (Pilâtre de Rozier and the Marquis d'Arlandes from Paris).*
Nov. 25	1783	Zambeccari's first public experimental balloon ascent in London.
Nov. 26	1783	Argand's aerostatic experiment before George III at Windsor.
Nov.	1783	Martyn's design of a balloon with parachute (published in ' Uses of Aerostatic Globes ', 1784).
Dec. 1	1783	*First ascent in an inflammable air balloon (Charles and Robert from Paris).*
Dec.	1783	Publication of ' The Air Balloon ', the first aeronautical treatise in English.
	1783	Hutton's experiments as to air-pressure on plane surfaces.
Feb. 9	1784	James Sadler's first experimental balloon at Oxford.
Feb. 22	1784	Experimental balloon crosses the Channel from Sandwich to Warneton.
Feb. 25	1784	*First balloon ascent in Italy (Andreani at Milan).*
Mar. 2	1784	*Blanchard's first balloon ascent at Paris.*
July	1784	*Meusnier's designs for a navigable balloon.*
July 15	1784	*First ascent of a cylindrical balloon (the Brothers Robert at St. Cloud).*
Aug. 11	1784	First attempted balloon ascent in England (' Count ' Moret at Chelsea).
Aug. 25	1784	First balloon ascent in Great Britain (Tytler at Edinburgh).
Aug.	1784	Crosbie's Aerostatic Chariot exhibited near Dublin.
Sept. 15	1784	Lunardi's first ascent in England.
Sept. 29	1784	Destruction of Keegan's fire-balloon at Portland Place.
Oct. 4	1784	Sadler's first ascent (in a ' Montgolfière ') at Oxford.
Oct. 16	1784	Blanchard's first ascent (with Sheldon) in England.
Oct. 29	1784	Pilon's ' Aerostation, or the Templar's Stratagem ', performed at Covent Garden Theatre.
Nov. 12	1784	Sadler's second ascent at Oxford (in a hydrogen balloon, from the Physic Garden).
Nov. 30	1784	Dr. Jeffries (with Blanchard) makes the first scientific observations from a balloon.

	1784	Blanchard's experiments with parachutes dropped from a balloon. (First tried in London on June 3.)
	1784	*Launoy and Bienvenu's experiments with small helicopters.*
Jan. 7	1785	Blanchard and Dr. Jeffries cross the Channel.
Jan. 19	1785	Crosbie's second ascent from Dublin.
Jan. 31	1785	Charles Green born.
	1785	Cavallo's 'History and Practice of Aerostation'.
Mar. 23	1785	Zambeccari's first ascent from London.
May 5	1785	Sadler's ascent with Wm. Windham at Moulsey Hurst.
May 16–19	1785	Sadler's ascents from Manchester.
May–June	1785	Blanchard's Balloon and Parachute Academy at Vauxhall.
June 1	1785	Deeker's ascent from Norwich.
June 3	1785	Major Money's ascent with Lockwood from London.
June 15	1785	*Pilâtre de Rozier and Romain killed near Boulogne.*
June 17	1785	Potain fails to cross the Irish Sea.
June 29	1785	Ascent of Biggin and Mrs. Sage (the first Englishwoman to ascend).
June	1785	Hoole's fish-formed aerostatic machine (described in 'Thoughts on the Improvement of Aerostation') exhibited in Cornhill.
July 12	1785	*First balloon ascent in Holland (Blanchard at the Hague).*
July 19	1785	Crosbie fails to cross the Irish Sea.
July 22	1785	Major Money's ascent from Norwich, and rescue from the sea off Yarmouth.
July–Aug.	1785	Lunardi's ascents from Liverpool.
Aug. 31	1785	Arnold's 'Royal Balloon' and Parachute, St. George's Fields.
Oct. 3	1785	*First balloon ascent in Germany (Blanchard at Frankfurt-am-Main).*
Oct.–Dec.	1785	Lunardi's ascents in Scotland.
	1789	*Baron Scott's 'fish-formed' navigable balloon (described in his treatise 'Aerostat dirigeable à Volonté').*
	1789–94	*Lunardi's continental ascents: Naples, Madrid, Lisbon, &c.*
July	1793	*First balloon ascent in America (Blanchard at Philadelphia).*
June 26	1794	*French Army first use military balloons at the battle of Fleurus.*
	1796	Cayley's experiments with a helicopter toy.
Oct. 22	1797	*Garnerin's first parachute descent in Paris.*
	1799	John Stringfellow born at Attercliffe, Sheffield.
June 28	1802	Garnerin's first balloon ascent in London.
Sept. 21	1802	First parachute descent in England (by Garnerin).
	1803	Major Money's 'Treatise on the Use of Balloons in Military Operations'.

July 31	1806	*Death of Lunardi at Lisbon.*
	1808	Cayley's earliest experiments with 'gliders'.
Mar. 7	1809	*Death of Blanchard at Paris.*
	1809–10	Cayley's earliest papers on 'Aerial Navigation' (heavier-than-air), in which he asserts that mechanical flight is possible.
	1809–12	Degen's trials with an ornithopter flying machine at Vienna, &c.
July 7	1810	Sadler's ascent from Merton Fields, Oxford.
	1810	Walker's 'Art of Flying by Mechanical Means'.
Aug. 12	1811	Sadler's ascent at Hackney.
Sept. 12	1812	*Zambeccari killed near Bologna.*
Oct. 1	1812	Sadler's attempt to cross the Irish Sea.
Aug. 1	1814	John Sadler's ascent from St. James's Park.
	1816	Cayley advocates large navigable balloons.
	1816–17	Pauly and Egg's 'Dolphin Balloon' (dirigible), constructed at Kensington.
July 22	1817	Windham Sadler's Channel-crossing from Dublin.
July 19	1821	Charles Green introduces coal-gas for inflation on his first ascent.
Sept. 5	1823	Graham's first ascent, his ballooning career (in conjunction with his wife) lasting up to about 1853.
May 25	1824	Harris's fatal accident at Beddington.
Sept. 29	1824	Windham Sadler killed near Blackburn.
Aug. 23	1825	Cornillot's ascent from Seal, near Sevenoaks.
Mar. 26	1828	Death of James Sadler at Oxford.
	1831	Second Edition of Walker's treatise.
	1835	Lennox's 'Eagle' airship in London.
Sept. 9	1836	First ascent of the 'Vauxhall (afterwards 'Nassau') Balloon'.
Nov. 7–8	1836	Voyage to Weilburg in the 'Vauxhall Balloon' (480 miles in 18 hours).
Mar.	1837	Prospectus of the Aeronautic Association issued.
July 24	1837	Cocking's parachute accident.
	1837	Cayley's design for a 'Navigable Balloon'.
	1838–9	Hampton's parachute descents.
May 24	1838	Destruction of Hoar's Great Montgolfier Balloon.
	1840	Green's project for crossing the Atlantic in a balloon.
	1842	Henson's 'First Carriage, the Ariel' (power-driven monoplane).
	1843	Cayley's 'Aerial Carriage' (mechanical flying machine).
Mar. 24	1843	Aerial Steam Transit Company Bill read a first time in the House of Commons.
	1843	Miller's 'Aerostat worked by Manual Power' (ornithopter flying mechanism).

	1843	Monck Mason's model aerial machine (dirigible balloon).
Aug. 19	1844	Coxwell makes his first balloon ascent with Hampton.
Aug.	1845	Coxwell publishes *The Balloon or Aerostatic Magazine.*
	1847	Gale's 'Newly Invented Aerostatic Machine'.
	1848	Stringfellow's first successful model flying machine (flown at Chard and at Cremorne Gardens).
	1850	*Jullien's model dirigible balloon flown at Paris.*
	1850	Bell's locomotive balloon flown at Vauxhall.
	1850–70	Ballooning fatalities arouse adverse public feeling.
Aug.	1852	Green's ascents with Welsh (under the auspices of the British Association).
Sept. 13	1852	Green's 500th balloon ascent.
Sept. 24	1852	*Giffard's steam-driven dirigible balloon flown at Paris.*
	1857	Death of Sir George Cayley.
	1859	Coxwell's first ascent from the Crystal Palace, Sydenham.
	1861	*Ponton d'Amécourt's steam-driven model helicopter.*
	1861	Bright's experiments with power-driven model helicopter.
Sept. 5	1862	Coxwell and Glaisher ascend to about 30,000 feet.
	1863	*Société d'Encouragement pour la Locomotion Aérienne founded in Paris.*
	1863	Coxwell advocates the military use of balloons.
	1864	Ascents of Eugene Godard's hot-air balloon in London.
	1865	Paul Haenlein's cylindrical balloon, with screw propellers (gas-engine).
	1865	The Duke of Argyll advocates 'heavier-than-air' flight.
Jan. 12	1866	Foundation of the Aeronautical Society of Great Britain (First Secretary, F. W. Brearey).
	1866	F. H. Wenham's paper on 'Aerial Locomotion'.
	1868	Moy predicts flying machines capable of 150 m.p.h.
June 25	1868	First Aeronautical Exhibition in England, organized by the Aeronautical Society at the Crystal Palace, Sydenham.
	1868	Stringfellow's model triplane flying machine.
Mar. 26	1870	Death of Charles Green.
	1870	Aeronautical Society's aerodynamic experiments on 'lift' and 'drag' ratios.
	1870–6	*Penaud's experiments with model flying machines.*
	1872	*Dupuy de Lôme's dirigible balloon flown at Vincennes.*
	1875	Moy's 'Aerial Steamer' tested round a circular track at the Crystal Palace.
	1882	*Tissandier's dirigible flown at Auteuil.*
	1883	Death of John Stringfellow.
Aug. 9	1884	*Renard and Krebs's dirigible 'La France' flown at Chalais Meudon.*
	1884–9	Lawrence Hargrave's experiments with model flying machines at Sydney.
	1885	Second Aeronautical Exhibition, Alexandra Palace.

	1890	Organization of the Balloon Section of the Royal Engineers.
	1891	*Chanute's articles on 'Progress in Flying Machines'.*
	1891	*Langley's 'Experiments in Aerodynamics' published at Washington.*
	1892	Lawrence Hargrave's experiments with cellular kites.
	1893	Horatio Phillips's multi-plane flying machine tested at Harrow.
June	1894	Baden-Powell's experiments with man-lifting kites.
Jan. 31	1896	Death of F. W. Brearey.
	1896	*Trials of Langley's power-driven 'Aerodrome' flying machine.*
	1896	Lilienthal killed in a gliding experiment.
Jan.	1897	Publication of the first number of *The Aeronautical Journal.*
	1897	*Trials with Clement Ader's 'Avion' flying machine.*
Sept. 30	1899	Pilcher killed in a gliding experiment at Market Harborough.
Jan. 5	1900	Death of Henry Coxwell.
July 2	1900	*Trial trip of the first Zeppelin airship over Lake Constance.*
Oct. 19	1901	*Santos Dumont navigates his airship round the Eiffel Tower.*
Feb. 7	1903	Death of James Glaisher.
Dec. 17	1903	*First flights by Wilbur and Orville Wright on a power-driven aeroplane, at Kill Devil Sand Hill, North Carolina.*
Aug. 11	1908	Death of F. H. Wenham.

APPENDIX II

ANNOTATED LIST OF THE MORE IMPORTANT PAPERS IN THE AERONAUTICAL SOCIETY'S REPORTS, 1866–93

The Reports were published annually from 1867 to 1883, numbered [First] to Seventeenth Report, the earliest bearing the title (taken from Wenham's paper), 'Aërial Locomotion'. The Eighteenth and Nineteenth Reports for 1883–4 were published together, as were also the Twentieth and Twenty-first for 1885–6. The Twenty-Second Report carried the record up to 1890, and the Twenty-third (and last) up to 1893. The series of twenty-three Reports are thus comprised in 21 volumes. It may be added that the first separate publications were Jas. Glaisher's address at the Council meeting, Jan. 12, 1866 (reprinted in the First Report), and F W. Brearey's paper on the Society's aims (4 pp.), read at Stafford House, Feb. 28, 1866.

1st Report, 1866.

Page 10.	Aerial Locomotion and the Laws by which Heavy Bodies impelled through the air are sustained [originally written in 1859, but including later experiments with gliding machines having 'superposed aeroplanes'].	F. H. Wenham.

Page 49.	Experiments made (ca. 1839) with steam-driven model Flying Machines, propelled by Wings or Screws.	F. D. A[rtingstall].

2nd Report, 1867.

Page 5.	Aerial Carriage with opposing fans [helicopters actuated by manual power], for controlling ascent and descent of Balloons.	H. Bright.
Page 9.	Aërial Machine on the principle of an inclined plane, impelled in the direction of its surface.	H. C. Hurry, C.E.
Page 13.	Remarks on the Present State of Aeronautical Science.	F. H. Wenham.
Page 17.	On the Flight of Birds.	F. D. Artingstall.
Page 20.	On the theory of the Flight of Birds as applied to an Aerial Machine.	Earl of Aldborough.
Page 32.	Experiments practically demonstrating the Laws by which Birds fly, and their application to an Aerial Machine [of cylindrical shape, with fixed wings (or aeroplanes), propelled by a screw actuated by a non-metallic 1 h p. gas engine].	W. Smyth, L.R.C.P. Edin.
Page 42.	Artificial Flight [by planes and wings—see Report for 1870, pp. 27 and 34; also Abridgments of Specifications: Aeronautics, No. 2420, 1861].	Major J. S. Phillips.
Page 58.	A Novel Apparatus for Aerial Locomotion [based on the principle of the kite, with the use of air-screws].	H. R. St. Martin.

3rd Report, 1868.

Page 5.	On the Control of Balloons by pressure [on inclined surfaces].	J. Heath.
Page 6.	The application of power in mechanical flight of more importance than its actual amount.	D. S. Brown.
Page 10.	Power in relation to Weight in Aerial Navigation.	A. Alexander, C.E.
Page 22.	Description of his Flying Engine [ornithopter actuated by compressed air].	F. D. Artingstall.
Page 27.	Thoughts on the Flight of Birds, and on extant theories of Artificial Flight by Aeroplanes and Wings.	J. Heath.

Page 36.	Explanation of an Aeromotive Engine [with wings and sustainers (or aeroplanes), as shown at the Exhibition, exhibit 38].	J. M. Kaufmann, C.E.
Page 39.	On Aeronautical Principles [criticizing the air-screw, but predicting flying machines capable of 150 m.p.h. See also p. 34 in the same Report].	Thomas Moy.
Page 48.	Practical Experiments in Flight [see also p. 30 of the Report for 1870].	Charles Spencer.
Page 49.	The Navigation of Balloons [1]	J. Luntley.
Page 53.	On Aerial Locomotion by Machinery, without Gaseous Buoyancy [see also p. 16 of the Report for 1879].	W. H. Phillips.
Page 56.	Some Remarks on Mechanical Flight.	David Meyer.
	Report of the First Exhibition held by the Society at the Crystal Palace, June 25–July 5, 1868.	

4th Report, 1869.

Page 7.	The Relation between the Velocity of a Current of Air and its Pressure on a Plain (*sic*) Surface of given size, shape and inclination.	Capt. Murray, R.N.
Page 9.	Upon the Relative Power and Surface in Mechanical Flying Machines . . . upon the thrust of Aerial Screw Propellers, &c.	T. Moy.
Page 16.	Remarks on Aërial Transcursion [superposed planes propelled by two steam-driven propellers].	J. M. Kaufmann.
Page 20.	On Aeronautics [Navigable Balloon with wings, or oscillating propellers].	R. C. Jay.
Page 26.	On the Economy of Using Power Intermittently for Aerial Support, also Observations on Light Motors [see Abridgments of Specifications: Aeronautics, No. 2346, 1873, &c.].	D. S. Brown.
Page 33.	Construction of an Aerial Machine [an impossible scheme for inducing artificial pressure under a rigid 'slab'].	R. Sheward.
Page 34.	On Aerial Navigation [mechanical flying machine, steam as prime mover].	H. F. Alexander.
Page 48.	The Flight of Birds, &c. in reference to Aerial Locomotion [37 pp., previously circulated as a separate paper].	De Lucy, of Paris.

[1] See Chap. XIII, p. 315.

5th Report, 1870.

Page 6. A Glance at Aeronautical Science [on common errors in 'aerostation' and 'aviation', the latter being an early use of the term]. — W. Clare.

Page 20. Account of Experiments in Wind Pressure made at Greenwich Observatory. — James Glaisher.

Page 23. An Instrument to Measure the Relative Pressure and Velocity of the Wind. — W. Smyth.

Page 36. On the Use of Wings in Birds in relation to an Inclined Surface. — F. D. Artingstall.

Page 40. Description of a Ptemametron [an instrument for recording the wing action of birds and insects, with diagrams, &c.]. — P. Sénécal.

Page 51. Upon the Work of the Committee for Administering the Experimental Fund of the Aëronautical Society. — A. Stewart Harrison.

Page 52. Description of an Aerial Machine [a combined ornithopter and parachute], with woodcuts. — Chalon.

Page 54. On the Angle of Impact of the Air on [Wing-Surfaces]. — W. Quartermaine.

Page 66. Observations on the Relative Size of the Wings and Weight of the Pectoral Muscles in the Vertebrated Flying Animals, translated by T. J. Bennett. — M. P. Harting, of Amsterdam.

6th Report, 1871.

Page 9. Aerial Flight, as dependent on Man's Muscular Exertion. — A. Alexander, C.E.

Page 15. Experiments made in January 1846, by J. Spiller, M.Inst.C.E., to ascertain the law of resistance to a passage of Air through pipes of different diameters and lengths at various velocities. — F. H. Wenham.

Page 25. Aerial Navigation [balloon with fan worked by four men]. — C. A. Bowdler.

Page 27. Description of a Model of Wing-Propellers. — R. C. Jay.

Page 29. Thoughts upon the Present Position of Aeronautical Science. — H. M. Sykes.

Page 49. An article from *L'Aeronaute* on Marey's 'Mechanism of Flight in the Animal Kingdom', translated by — T. J. Bennett.

Page 62. Communication on Bird Flight, Aeroplane Flight by Man, &c. — D. E. Gostling, C.E., Bombay.

Page 75. Data obtained from experiments upon the action of a Current of Air on inclined Planes [undertaken at Penn's Engineering Works, Greenwich, by F. H. Wenham in conjunction with John Browning]. — [F. W. Brearey].

7th Report, 1872.

Page 6. Account of Experiments with a Machine for measuring the relation between the velocity and pressure of wind on a plane (see above). — F. H. Wenham.

Page 12. On Flight. — Head, of New Zealand.

Page 19. On the application of Scott Russell's Wave-line to Aërial Machines. — T. Moy.

Pages 25–74. Extracts from E. J. Marey's 'Lectures on the Phenomena of Flight in the Animal Kingdom', with diagrams, translated by — T. J. Bennett.

Page 75. Remarks on Dupuy de Lôme dirigible, &c. — [F. W. Brearey].

8th Report, 1873.

Page 13. The Aèroplane: its Construction, Stability, and Means of Propulsion. — D. S. Brown.

Page 20. Demonstration of a model steam-engine [7 lbs. per h.p., steam 100 lbs. to an inch, revs. 800 per minute] designed by T. Moy and R. Shill [an account of their 'Aerial Steamer' is given in the Concluding Remarks, p. 81, and Ninth Report, p. 69. An illustration is given as Fig. 106 of the present work].

Pages 26–80. Wings for Man [mathematical calculations on the sustaining power of planes disposed round the axis of a wheel]. — James Armour, C.E.

9th Report, 1874.

Page [6]. Calculations made on the results of the experiments at Greenwich [see Report for 1872, p. 6]. — T. Moy.

Page 14. The Aero-Bi-Plane, or First Steps to Flight, with diagrams [fore and aft planes with stabilizing tail, and wings for propulsion; demonstration models exhibited]. — D. S. Brown.

Page 23. Resistance to Falling Planes on a Path of Translation. — J. Armour.

Page 49. Notes from France [references to Penaud's helicopter, aeroplane, and flapping-wing models, &c., with diagrams]. — T. J. Bennett.

10th Report, 1875.

Page 6. On Aeronautical Progress [with particular reference to experiments with the 'Aerial Steamer' at the Crystal Palace]. — T. Moy.

Page 16. On the Death of Crocé-Spinelle and Sivel [asphyxiated in the balloon 'Zenith', April 15, 1875]. — J. Glaisher.

Page 30. Experiments in Guiding Balloons [hot-air balloon, deflections obtained from 'ascensive' and 'descensive' motion, translated from the French]. — Menier.

Page 34. Angus and Mack on the Air Path [a popular exposition of aeronautics, in dialogue form, two supplts. to which were subsequently published separately. — [J. Armour].

Page 67. Experimental Researches upon the Influence of Atmospheric Changes upon the Phenomena of Life, translated by J. Glaisher. — Paul Bert.

Page 72. On the Employment of Oxygen in Respiration, translated by J. Glaisher. — A. Gaudin.

11th Report, 1876.

Page 1. The Advantages of Employing Intermittent Power for Aerial Propulsion, and on the Soaring of Birds. — D. S. Brown.

Page 9. Air Compression under Wing-Planes. — J. Armour.

Page 21. Reply to some Remarks [by William Pole, F.R.S.] in the *Quarterly Review* for 1875 [which supported dirigible balloons as against flying machines]. — T. Moy.

Page 35. The Power Developed by Birds (read before the Société Philomathique de Paris). — A. Penaud.

Page 45. Laws relating to Planes gliding in the Air (translated from *L'Aeronaute* by T. J. Bennett). — A. Penaud.

Page 60.	On Aerial Navigation (Reprinted from *Nicholson's Journal* for 1809 and 1810).	Sir George Cayley.

12th Report, 1877.

Page 8.	The Problem of Flight [illustrated by the flight of models].	F. W. Brearey.
Page 20.	The Choice of Means for Experimenting in Aëronautics.	T. Moy.
Page 26.	Treatise upon the Art of Flying (Reprinted from the Hull edition of 1810).	Thomas Walker.

13th Report, 1878.

Page 7.	Aeronautical Progress.	T. Moy.
Page 16.	Remarks upon Bird-Flight and its imitation by Mechanical Models.	F. W. Brearey.
Pages 30–69.	Two Papers on the Flight of Birds and Aërial Navigation.	Henry Sutton, Ballarat.

14th Report, 1879.

Page 8.	Aëronautics [experiments with an apparatus for calculating pressure on planes in motion].	T. Moy.
Page 16.	Mechanical Action on the Air [reaction engine, with gaseous steam generator].	W. H. Phillips.
Page 25.	Artificial Flight.	F. W. Brearey.
Page 60.	On the abolition of the Top Valve of the Balloon [with extracts from Meusnier's 'Memoir on the Equilibrium of Aerostatic Machines'].	

15th Report, 1880.

Page 7.	Amount of Motive Power Required and Means available for obtaining that Power for Aërial Machines.	T. Moy.
Page 14.	Ballooning in connexion with Arctic Expeditions [in the discussion Coxwell and Moy engage in argument as to ballooning versus aviation].	Capt. Cheyne, R.N.
Page 26.	In condemnation of Gas as an aid to Aerial Machines.	F. W. Brearey.
Page 31.	Flight of certain Sea-Birds [from the *English Mechanic*, June 1880, and correspondence relating thereto].	R. A. Proctor, F.R.A.S.

16th Report, 1881.

Page 20. The Problem and Prospects of Aerial Navigation [mainly on the utility of Balloons]. — D. Scoffern.

Page 42. The Problem of Aerial Navigation [by Navigable Balloons] as affected by recent Mechanical Improvements (reprinted from the Proceedings of the Civil Engineers, vol. 67). — W. Pole, F.R.S.

Page 80. Obituary Notice of Henri Giffard.

17th Report, 1882.

Page 1. Method for Measuring Air Velocities. — E. Serrell, Junr.

Page 15. How to Sail in the Air by the Use of Wings, as in Nature's Example [with particular reference to the application of the gas-engine]. — J. M. Rogers.

Page 22. The Effect of the Pectoral Muscle on the Flight of the Bird [as demonstrated by models]. — F. W. Brearey.

Page 27. Remarks on the Subject of Aerial Navigation [wing-propelled flying-machines]. — C. Whittell, C.E., Sydney.

Page 46. The Flight of Sailing Birds [based on observations in Florida, &c., over 30 years]. — J. Lancaster, Chicago.

Page 67. Correspondence on Flying Machines, from *The Engineer* ', Dec. 1882–Jan. 1883 [contributions by H. S. Hele Shaw, etc.].

18th Report, 1883.

Page 1. Aeronautics, with Remarks on a Visit to the Aeronautical Exhibition in Paris. — E. P. Frost.

Page 16. On the Mechanics of Flight and their application to Flying Machines. — H. Middleton.

Page 55. Memoir of John Stringfellow. — F. W. Brearey.

19th Report, 1884.

Page 68. A Light and Economical Motor for Propulsion in Air [jet propulsion by the use of gas. A further paper appeared in Report for 1886, p. 67]. — Capt. T. Griffiths.

Page 75. Artificial Flight Attainable [on the principle of the plane, propelled by steam-driven air-screws]. — S. W. Hollands, Chatham Dockyard.

Page 85. The Possibility of Man-Flight. E. A. Barry.
Page 96. Conjoint Gas and Mechanical Action as applied to Flight. F. W. Brearey.
Page 101. Flight of Sailing Birds [continuation of paper in Report for 1882, p. 46]. J. Lancaster.

20th Report, 1885.

Page 9. The Meudon Balloon Experiments [accounts of trial flights of the navigable balloon designed by Renard and Krebs, in Aug.–Nov. 1884]. E. A. Barry.
Page 29. Aerial Motor Design [see Report for 1884, p. 75]. S. W. Hollands.

Note.—An Aeronautical Exhibition under the patronage of the Society was held at the International Exhibition, Alexandra Park, in June, 1885.

21st Report, 1886.

Page 48. Gravity and Wind-Pressure as Auxiliary Powers in Flight. S. W. Hollands.
Page 55. Balloon Signalling in War [see also 22nd Report, p. 30]. Eric Bruce.
Page 59. Experimental Ballooning [a critical account of the trial of a navigable balloon constructed in France by F. A. Gower]. F. W. Brearey.
Page 74. The Problem of Aërial Navigation [on the present position of the navigable balloon]. E. A. Barry.

22nd Report, 1887–1890.

Page 1. Kite Balloons and Kite Tandems. D. Archibald.
Page 20. A New Method of ascertaining the Power required for propelling Balloons and other Bodies through the Air [by means of an apparatus invented by Beugger]. J. Wetter.
Page 32. The Fundamental Principle of Flight [a mathematical demonstration of the impracticability of 'a flying machine of the aeroplane type' and advocacy of winged flight]. H. Middleton.
Page 98. Account of Sir Hiram Maxim's Flying Machine [in Concluding Remarks]. F. W. Brearey.

23rd Report, 1891–1893.

Page 9. Aerodynamic Experiments. Sir H. Maxim.
Page 16. Aerial Machine with Wings built up of Artificial Feathers [see illustration in 22nd Report, p. 98]. E. P. Frost.

Page 22.	The Flight of the Seagull.	E. A. Barry.
Page 41.	Working of Captive Balloons in Windy Weather.	Eric Bruce.
Page 45.	Is Flight by Man-Power Possible ?	Green, of Barrow-in-Furness.
Page 55.	Remarks on Experiments made by Horatio Phillips.	F. W. Brearey.
Page 65.	On the Sustentation of Weight by Mechanical Flight. (See Ch. XII, p. 284 *ante*).	Horatio Phillips.

NOTE.—Between about 1879–89 members of the Society also read papers before the Balloon Society of Great Britain, which existed between the aforesaid dates, and attained the dignity of awarding medals. The President was W. H. Le Feuvre, for many years a member of the Ae.S G.B.

APPENDIX III

BIBLIOGRAPHY

The following selective bibliography is comprised mainly of books and pamphlets used in the present work. Beyond that an endeavour has been made to include a proportion of such of the more important, interesting, or rare aeronautical books, as may be of use to the historian or student, the enumeration of which may also act as a guide to collectors. But the omission of any title must not be taken to mean that the compiler is unaware of it. For list of bibliographies mainly used in this selection see p. 414.

GENERAL SURVEY, PARTS I AND II

HISTORICAL WORKS

AMBROSINI (R.). *L'Aeronautica a Bologna.* 102 pp. Plates. 8vo. Bologna, 1912

A useful compilation of contemporary records referring to Zambeccari, Andreoli, Orlandi, Muzzi, and other pioneers.

ANDREANI (P.). *Il Viaggio Aereo dell' Illustre Cavalier Milanese Don Paolo Andreani.* 15 pp. Sm. 8vo. Milano, 1784

The above account of the first hot-air balloon ascent in Italy was written by Carlo Castelli in a letter to Faujas de St.-Fond. There were several editions, including translations into French.

BERGET (A.). *The Conquest of the Air: Aeronautics—Aviation: History: Theory: Practice.* Illustrations. 8vo. 1909

A translation of the author's *Ballons, Dirigeables et Aéroplanes,* 1908. The historical chapters, though brief, are sound as far as they go.

BOFFITO (G.). *Il Volo in Italia.* 8vo. Firenze, 1921

A scholarly and comprehensive history, concisely written, with references to original sources, and textual quotations from the classics, the schoolmen, and early scientists.

BOURGEOIS (D.). *Recherches sur l'Art de Voler, depuis la plus haute antiquité jusqu'à ce jour.* 143 pp. 8vo. 1784

One of the earliest histories of flight, written as a supplement to Faujas de Saint-Fond (q.v.).

BRUEL (F.-L.). *Histoire Aéronautique par les Monuments . . . des Origines à 1830.* 206 reproductions of old engravings, portraits, autographs, &c. 4to. 1909

A fine work, invaluable for reference on account of the illustrations. It is, however, weak as to English aeronautical history in plates as well as in text. A supplement (coming down to the Great War), compiled jointly by Comte de La Vaulx, P. Tissandier, and C. Dollfus, was issued under the title of:

L'Aéronautique des Origines à 1922. 110 reproductions. 4to. 1922

Though abbreviated for reference (in the present work) to La Vaulx, the text of the foregoing was wholly written by MM. Tissandier and Dollfus.

CARVALHO (H. de). *Navegacão aerea. A Conquista dos Aeres, de Bartholomeu de Gusmão a Santos Dumont* (1709–1901). 8vo. São Paulo, 1901

CHANUTE (O.). *Progress in Flying Machines.* 308 pp. Woodcuts. 8vo. New York, [1894]

The most comprehensive and accurate account of the evolution of mechanical flight. The same author also published a pamphlet on *Aerial Navigation*, 36 pp., N.Y., 1891, which deals with airships as well as mechanical flight.

DARBOUX (G.). *Notice Historique sur le Général Meusnier.* 4to. 1909

DEBIÈVRE (E.). *Notes sur l'Histoire de l'Aérostation dans la Région du Nord de la France* (1783–1851). 65 pp. Plate. 8vo. Paris-Lille, 1895

DERVAL (E.). *Étude sur la Navigation aérienne . . . Aérostat de Meudon . . . Aérostat de Meusnier et de Dupuy de Lôme*, &c. 239 pp. Plates. 8vo. 1889

DUPUIS-DELCOURT (J.-B.). *Nouveau Manuel Complet d'Aérostation, ou Guide pour servir à l'Histoire et à la Pratique des Ballons.* Plates. 12mo. (Manuels-Roret), 1850

A useful and comprehensive little volume, based on original sources and in the main reliable. Dupuis-Delcourt, himself an aeronaut, knew both Montgolfier and Charles, as well as Potain, Garnerin, Deegan, Lennox and others.

Encyclopaedia Britannica, Eleventh Edition. See Articles on Aeronautics, Flight and Flying, Parachutes, &c. 1910–11

The subject of aeronautics was first introduced into the *Ency. Brit.* in the Third Edition, 1797, under Aerostation. In the joint supplement to the Fourth, Fifth, and Sixth Editions, it was re-written by Sir John Leslie under the heading Aeronautics, 'now generally adopted to express aerial navigation.' In the Ninth, 1875, it was revised by James Glaisher, and an article on Flight and Flying-Machines by J. Bell Pettigrew was added. In the Supplementary Volumes, 1903 (forming the Tenth Edition), the former article was brought down to date. In the Eleventh, 1910, the article Aeronautics was re-written, that on Flight and Flying was supplemented, and an inadequate one on Parachutes added. Similar works of reference, now obsolete (e. g. *Encyclopaedia Londinensis*, 1797–1829, Rees, 1819, *Encyclopaedia Metropolitana*, 1845, &c.), treated the subject on much the same lines, though the entry is sometimes under Balloon or Air-Balloon.

FARIA (Le Vicomte de). *Bartholomeu Lourenço de Gusmão* (1685–1724), *Inventeur des Aérostats*. Plates. 8vo. Lausanne, 1911

In 1917 the same author reproduced in facsimile a ' dessin à la plume ' (said to date back to 1709) describing Gusmão's aeronautical machine. Cf. I.L.A. no. 953.

FAUJAS DE SAINT-FOND (B.). *Description des Expériences de la Machine Aérostatique de MM. de Montgolfier, &c.* Engravings. 8vo. 2 vols. chez Cuchet, 1783–4

The first authoritative treatise—historical and technical—on aerostation, the second volume of which bears the title *Première suite de la Description*, &c. Translations into Italian, German, and Dutch appeared at Venice, Leipzig, and Amsterdam in 1784.

FONVIELLE (W. de). *Aventures Aériennes et Expériences Mémorables des Grands Aéronautes.* 1876

A popular but generally accurate account of the history of ballooning. An English edition appeared as :

Adventures in the Air. Translated and edited by John S. Keltie. Illustrations. 304 pp. 1877

FORSTER (T.). *Annals of some Remarkable Aerial and Alpine Voyages, including those of the Author, with Observations on the Affections to which Aerial and Mountain Travellers are liable.* 118 pp. 8vo. 1832

A useful record of early balloon ascents, though inaccurate as to details. The author—whose full name was Thomas Ignatius Maria Forster (1789–1860)—was a distinguished naturalist and astronomer. On April 30, 1831, he ascended from Moulsham, near Chelmsford, in order to make observations on the physical sensations experienced in a high ascent (*Annals*, &c., p. 74). He published some comparative notes on the subject in *Medicina Simplex*, 1832.

FULD (E.). *Uit de Eerste Jaren der Luchtvaart in Nederland, 1700–1808.* 71 pp. 12 plates. 8vo. Amsterdam (Niet in den handel), 1918

[GÉRARD (L. G.).] *Essai sur l'Art du Vol Aérien.* Plate. 8vo. 1784

One of the earliest rational examinations of flight in general, historical and practical. The author, though recognizing the value of the balloon, urged the possibility of flight ' par les seules loix de la mechanique '.

GRAND-CARTERET (J.) et LÉO DELTEIL. *La Conquête de l'Air vue par l'Image* (1495–1909). 470 illustrations. 4to. [1910]

A useful book for the collector of old aeronautical engravings. The notes on English aeronauts are not reliable.

GUSMÃO (B. L. de). See under FARIA (Le Vicomte de) and WILHELM (B.).

HILDEBRANDT (A.). *Airships Past and Present, &c.* Translated [from the German] by W. H. Story. Illustrations. 8vo. 1908

HIRSCHAUER (Ch.). *Notes sur l'Histoire de l'Aérostation dans le Pas-de-Calais.* Arras, 1910

HIRSCHAUER (Ch.). *Les Premières Expériences Aérostatiques à Versailles, 1783–4.* 67 pp. Plates. 8vo. Versailles, 1917

The two preceding monographs contain authoritative accounts of certain of the earliest balloon exploits in France, with ample references to the original sources.

HOERNES (H.). *Buch des Fluges,* 1635 illustrations. 3 vols. Wien, 1911.

LANDELLE (G. de La). *Dans les Airs: Histoire Élémentaire de l'Aéronautique.* 288 pp. 8vo. 1884

A reliable and comprehensive survey.

LECORNU (J.). *La Navigation Aérienne: Histoire documentaire et anecdotique.* Illustrations. Imp. 8vo. 484 pp. 1903

A comprehensive and generally reliable work, with over 350 illustrations. A Fourth Edition appeared in 1910.

MAREY-MONGE (E.). *Études sur l'Aérostation.* Plates. 8vo. 1847

A scientific treatise, but containing valuable notes on Meusnier's dirigible, &c.

MARION (F.). *Les Ballons et les Voyages Aériens.* 328 pp. Illustrations. 8vo. 1867

A readable history of a popular kind. An English edition appeared as:

Wonderful Balloon Ascents, or the Conquest of the Skies, A History of Balloons, &c. 218 pp. Illustrations. 8vo. 1888

MARSH (Lt.-Col. W. Lockwood). *Aeronautical Prints and Drawings.* 99 Reproductions, Text 34 pp., 4to. 1924

MEANS (J.). *The Aeronautical Annual.* Reproductions and other plates. 3 vols. 8vo. Boston, Mass., 1895–7

A useful compilation of reprints (Cayley, Walker, &c.) and original articles (by Otto Lilienthal, P. S. Pilcher, Octave Chanute, &c.), mostly dealing with mechanical flight. An *Epitome* in one volume was published in 1910.

MOEDEBECK (H. W. L.). *Pocket-book of Aeronautics, in collaboration with Octave Chanute,* &c. Translated by W. Mansergh Varley. Illustrations. Sm. 8vo. 496 pp. 1907

Contains historical notes on the various aspects of aeronautics. The original German edition (*Taschenbuch zum praktischen Gebrauch fur Flugtechniker und Luftschiffer*) was published at Berlin in 1895. A fifth German edition (revised) was published in 1923.

MOEDEBECK (H. W. L.). *Handbuch der Luftschiffahrt.* Illustrations, 8vo. 2 vols. in 1 (Geschichte, 200 pp.—Theorie, 210 pp.). Leipzig, 1886

Dr. L. Liebmann recently told the writer that the historical section of the above is still the best authority in German.

MONTGOLFIER (J.-M. and E.-J.). See Rostaing (L.).

ROSTAING (L.). *La Famille de Montgolfier.* 8vo. Lyon, 1910

An exhaustive work. The aerostatic experiments of Joseph and Étienne are related in Chap. X.

[ROZIER (A.-G.).] *Dissertation sur les Aérostats des Anciens et des Modernes,* par A. G. Ro****. 8vo. 4+176 pp. Genève, 1784

Also attributed to A. G. Robert. Contains the Latin text of the references commonly made to Aulus Gellius, Schott, Cardan, Kircher, &c.

SAZERAC DE FORGE (L.). *La Conquête de l'Air.* 378 pp. Illustrations. 8vo. 1907

Deals with the modern development of dirigible airships.

SIRCOS (A.) et TH. PALLIER. *Histoire des Ballons et des Ascensions Célèbres, avec une Préface de Nadar.* Illustrations. 469 pp. Imp. 8vo. 1876

TISSANDIER (Gaston). *Histoire des Ballons et des Aéronautes Célèbres, 1783–1890.* Illustrations. 2 vols. 8vo. 1887–90

An important and finely illustrated work. The sections dealing with English ballooning annals are inadequate and the accounts sometimes inaccurate.

—— *La Navigation Aérienne, l'Aviation et la Direction des Aérostats dans les temps anciens et modernes* (*Bibliothèque des Merveilles*). 334 pp. 1886

TURGAN (J.). *Les Ballons. Histoire de la Locomotion Aérienne . . . jusqu'à nos Jours.* Avec une introduction par Gérard de Nerval. Woodcuts. 208 pp. 12mo. 1851

TURNER (C. C.). *The Romance of Aeronautics. An . . . Account of the Growth and Achievements of all Kinds of Aerial Craft.* Illustrations. 314 pp. 1912

TURNOR ([C.] Hatton). *Astra Castra: Experiments and Adventures in the Atmosphere.* Plates and woodcuts. 530 pp. 4to. 1865

A voluminous but ill-arranged and often inaccurate compilation. Of 530 pp. about 350 are quotations and extracts, or reprints of entire books. The bibliography and chronology are inadequate and unreliable. The last 26 pp. are quotations—wholly irrelevant—on religious themes, mainly from Southgate's *Many Thoughts for Many Minds* !

VALENTINE (E. S.) and TOMLINSON (F. L.). *Travels in Space.* Plates. 324 pp. 8vo. 1902

A popular but unreliable history, the earlier chapters mainly compiled from Hatton Turnor's *Astra Castra.* The character of the book is sufficiently revealed in the reference (p. 7) to Wilkins's *Mathematical Logic.*

VIVIAN (E. C.). *A History of Aeronautics,* with a Section on Progress in Aeroplane Design by Lt.-Col. W. Lockwood Marsh. Plates. 8vo. 1921

A comprehensive history up to 1920, but the early chapters on the 'Evolution of the Aeroplane' and on 'Aerostatics' are not reliable.

WILHELM (B.). *Die Anfange der Luftfahrt Lana-Gusmão, zur Erinnerung an den 200. Gedenktag des ersten Ballonaufstieges* (1709–1909). Plates. Hamm i. W., 1909

WISE (J.). *A System of Aeronautics, comprehending its Earliest Investigations,* &c. Illustrations. 310 pp. 8vo. Philadelphia, 1850

—— *Through the Air . . . comprising a History of the Various Attempts in the Art of Flying,* &c. Illustrations. 650 pp. 8vo. Philadelphia, 1873

Neither of these books—mainly dealing with Wise's own experiences—are reliable as to early history. Hatton Turnor quoted largely from the first named, of which the latter is practically an enlarged second edition.

SCIENTIFIC AND TECHNICAL WORKS

BARONI (Clemente, Marchese di Cavalcabò). *L'Impotenza del Demonio di trasportare a talento per l'aere*, &c. 141 pp. 8vo. Rovereto, 1753

BERTHOLON (l'Abbé). *Des Avantages que la Physique, et les Arts qui en dépendent, peuvent retirer des Globes Aérostatiques.* 82 pp. 8vo. Montpellier, 1784

BORELLI (J. A.). *De Motu Animalium.* Plates. 2 vols. Sm. 4to. Roma, 1680–1

First Edition. The proposition (204), 'Est . . . impossibile, ut homines propriis viribus artificiose volare possint,' appears in Part I, with a plate (13). Other editions were printed at Leyden 1685 and 1710, Naples 1734, and The Hague 1743. An English translation published as Aeronautical Classics, No. 6, diagrams, 8vo. 1911.

BRISSON. *Observations sur les Nouvelles Découvertes Aerostatiques, et sur la probabilité de pouvoir diriger les Ballons.* 63 pp. 8vo. 1784

[CALVI (Stefano).] *Metodo di dirigere i Palloni ad Aria Infiammabile*, &c. 37 pp. Plate. [Milano, 1784]

CARRA [J.-L.]. *Essai sur la Nautique Aérienne, contenant l'Art de diriger les Ballons Aérostatiques à volonté*, &c. 23 pp. Plate. 8vo. 1784

CHARLES (J.-A.-C.). *Représentation du Globe Aérostatique qui s'est élevé de dessus l'un des bassins du Jardin Royal des Thuilleries le 1er décembre 1783 . . . Avec le récit de son voyage aérien* [from the *Cours de Physique* of M. Charles], in French and Italian. 15 pp. 4to. 2 folding plates. [1783]

DEGEN (J.). *Beschreibung einer neuen Flugmaschine.* 4to. Plate. Wien, 1808

DORVEAUX (Dr. P.). *Pilâtre de Rozier, Apothicaire.* 8vo. 1921

DUCHESNE JEUNE. *Exposé de Divers Systèmes de Navigation Aérienne et Réfutation de l'Hélicoptère Nadar, Ponton d'Amécourt et De La Landelle.* 12mo. 1864

DU PRÉ (F.). *Memoria sull' Aerostato di Pasqual Andreoli.* 99 pp. Plate. 8vo. Venezia, 1807

DUPUIS-DELCOURT (J.-B.). *Mémoire sur l'Aérostation et la Direction Aérostatique.* 40 pp. 4to. 1824

—— *Essai sur la Navigation dans l'Air.* 40 pp. 8vo. 1830

DUPUY DE LÔME. *Note sur l'Aérostat à hélice, construit pour le compte de l'État.* Plates. 4to. 1872

ESTERNO (M. d'). *Du Vol des Oiseaux. Indication des Sept Lois du Vol Ramé et des Huit Lois du Vol à Voile.* 8vo. Plates. 1864

FLAYDER (F. H.). *De Arte Volandi.* 45 pp. 8vo. [Tübingen], 1628

GALATHEAU (de). *Dissertation touchant l'Empire de l'Homme, qu'il n'a pas eu besoin d'Aisles, et qu'il n'a peu ny deu voler.* 12mo. 1676

GALIEN (R.-P. J.). *L'Art de naviguer dans les Airs. Amusement Physique et Géométrique.* 12mo. Avignon, 1755

A Second Edition (revue et corrigée), 88 pp., 12mo, was published in 1757. Both editions are very rare. See facsimile title of the latter (priced £75) in Maggs's catalogue No. 435, 1923, p. 5.

[GÉRARD (L. G.).] *Essai sur l'Art du Vol Aérien.* 178 pp. Plate. 12mo. 1784

GERLI (A. [G. and C. G.]). *Opuscoli, engraved title, &c.*, 4 ll., pp. 1–99. 13 plates, and engravings in the text. Folio. Parma, 1785

The first section (Relazione della Macchina Aereostatica, &c., 32 pp.) describes the hot-air balloon constructed for Andreani. It is illustrated by 3 engravings in the text and four full-page plates. Rare. See also above under Andreani (P.). Five years later the three brothers Gerli published a pamphlet entitled *Maniera di migliorare e dirigere i Palloni Aerei*, &c , 52 pp., with two plates. Rome, 1790.

GIFFARD (Henri). *Application de la vapeur à la Navigation Aérienne.* 28 pp. Plate. 4to. 1851

—— See also Tissandier (G.).

HUBER (Jean). *Observations sur le Vol des Oiseaux de Proie.* 7 plates. 4to. Genève, 1784

Huber also wrote a *Notice sur la manière de diriger les Ballons*, &c. (*Mercure*, Dec. 13, 1783).

KAISERER (J.). *Ueber meine Erfindung einen Luftballon durch Adler zu regieren.* 16 pp. Plate. Sm. 4to. Wien, 1801

Very rare. The copy in the library of the Royal Aeronautical Society has the folding plate coloured. A facsimile reprint was issued in 1903.

LACZYNSKI (C. J. M. von). *Theorie der Aeronautik oder mathematische Abhandlung uber die Leitung der Aerostaten durch Ruder*, &c. 65 pp. 4 folding plates. Mohrungen, 1833

An edition in French was published in Paris the same year. An early treatise on airship theory considered mathematically.

LANA [Terzi] (F. de). *Prodromo overo saggio di alcune inventioni nuove premesso all' Arte Maestra.* Title, &c., 4 ll., pp. 1–252. 20 plates. Folio. Brescia, 1670

The sixth chapter on the 'aerial ship' was reprinted separately the same year under the title of *La Nave Volante* [Brescia, undated, with plate]. On the invention of the balloon by Montgolfier it was again reprinted at Milan, Rome, and Messina (under the foregoing or longer title) in 1784. An English translation of Chaps. V and VI (the former being notes on flying automata) was published in the Aeronautical Classics, No. 4, 1910. See also under HOOKE (R.), Chap. II, p. 399 *post.*

—— *Magisterium Naturæ et Artis.* Plates. 3 vols. Folio. Brixiæ—Parmæ, 1684–92

Volume ii (Lib. VI, Art. XLVI) contains a chapter on the principle of the 'Aerial Ship'.

LAUNOY et BIENVENU. *Instruction sur la nouvelle Machine inventée par MM. Launoy, Naturaliste, et Bienvenu, Machiniste-Physicien.* 15 pp. 12mo. [1784]

This rare *brochure* served as an admission ticket to view the three helicopter models then on exhibition at the house of Bienvenu in the Rue de Rohan, Paris.

LUNARDI (Vincenzo). *Tratado das Máquinas Aerostaticas, com a descripção da Máquina Aerostatica do Capitão Lunardi, &c.* 48 pp. and plate. 12mo. Lisboa, 1794

For details and authorities on Lunardi's exploits in Italy and Spain, see Boffito, Chap. XVII.

MAREY (E.-J.). *Mémoire sur le Vol des Insectes et des Oiseaux.* 8vo. 1872

—— *Le Vol des Oiseaux.* 8vo. 1890

Marey also published a treatise on *Développement de la Méthode Graphique par l'emploi de la Photographie,* 1885.

—— *Animal Mechanism: A Treatise on Terrestrial and Aerial Locomotion.* [Translated from the French.] 278 pp. Illustrations. 8vo. 1874

MEERWEIN (C.-F.). *L'Art de Voler à la Manière des Oiseaux.* 48 pp. 2 plates. 8vo. Basle, 1784

[MERSENNE (Marin).] *Questions inouyes, ou Recreation des Scavans.* 8vo. 1634

The first question is: A sçavoir si l'art de voller est possible, et si les hommes peuvent voller aussi haut, aussi loin et aussi viste que les oyseaux—an early reference to the possibility of flight, known probably to Bp. Wilkins, who in *Mathematical Magick,* 1648, quotes Mersenne's description of a submarine.

MEUSNIER (J.-B.-M.). *Mémoire sur l'équilibre des Machines Aérostatiques,* &c. . . . Présenté à l'Académie 3 Dec. 1783. 31 pp. 4to. [1784]

—— *Atlas des dessins relatifs à un Projet de Machine Aérostatique.* 16 plates reproduced from the originals.

A set of the water-colour drawings of Meusnier's remarkable designs is preserved in the Aeronautical Museum at Chalais Meudon. Cf. *I.L.A.*, No. 981, and accompanying illustrations.

MORVEAU [L.-B. Guyton] de, CHAUSSIER, et BERTRAND. *Description de l'Aérostat L'Académie de Dijon, &c.*, 224 pp. 4 plates. 8vo. Dijon, 1784

MOUILLARD (L.-P.). *L'Empire de l'Air: Essai d'Ornithologie appliquée à l'Aviation.* Illustrations. 284 pp. 8vo. 1881

MUZZI (M.). *Descrizione dell' Aereonave rettirèmiga inventata da M. M., Bolognese.* 10 pp. and plate. Bologna, 1838

Reprinted, with additions, 23 pp. (and a similar folding plate of Muzzi's *Nave Aerortoploa* of 1834 and 1838), at Florence, 1839.

NADAR (pseud. Félix Tournachon). *Mémoires du Géant.* 439 pp. Sm. 8vo. 1864

—— *Le Droit au Vol.* 115 pp. Sm. 8vo. 1865

An English translation [with a Biographical Notice] by J S. Harry was published in London under the title *The Right to Fly,* 96 pp., sm. 8vo, 1866.

ORLANDI (Francesco). *Descrizione dell' Aerobata o Macchina Aereobatica.* 14 pp. Plate. Bologna, 1824

At least eighteen or twenty pamphlets describing Orlandi's ascents and his combined hydrogen and hot-air balloon were published at Bologna, Verona, Padova, Pisa. Florence, Parma and elsewhere, between 1824 and 1847. A *Descrizione della nuova Macchina Aereobatica*, 14 pp., Padova, 1844, contains both a portrait and plate of the balloon, the latter being almost identical with that in Zambeccari's *Descrizione, &c.*, Bologna, 1803.

PAUCTON (A.-J.-P.). *Théorie de la vis d'Archimède, de laquelle on déduit celle des Moulins conçus d'une nouvelle manière.* 214 pp. 7 plates. 8vo. 1768

PENAUD (A.). *Discours prononcé le 14 Mars 1878.* 8vo. 1878

PETTIGREW (J. Bell). *Animal Locomotion, or Walking, Swimming, and Flying. With a Dissertation on Aeronautics.* 280 pp. Illustrations. 8vo. 1873

Several times reprinted. The work is based on Pettigrew's earlier studies—' On the Various Modes of Flight in Relation to Aëronautics ' (*Proceedings of the Roy. Inst.*, Mar. 22, 1867), and ' On the Mechanical Appliances by which Flight is attained in the Animal Kingdom ' (*Linn. Soc. Trans.*, vol. xxvi). The conflicting views of Pettigrew and Marey were dealt with by Prof. Coughtrye in a paper on ' Aerial Locomotion ' (*Quart. Journal of Science*, April, 1875).

PEYREY (F.). *Les Oiseaux Artificiels, avec une Préface de Santos-Dumont.* Illustrations. 667 pp. 8vo. 1909

Mainly deals with modern achievements in flight, but contains interesting refer ences to the earlier pioneers—Cayley, Henson, Penaud, &c.

PONTON D'AMECOURT (Vte. de). *La Conquête de l'Air par l'Hélice.* 40 pp. 8vo. 1863

—— *Collection de Mémoires sur la Locomotion Aérienne sans Ballons.* 152 pp. 4to. 1864–7

RENARD (Ch.). *Notice sur les Travaux Scientifiques de M. Ch. Renard.* 1919

ROBERTSON (E. G.). *La Minerve, Vaisseau Aerien.* 36 pp. Woodcuts and plate. 8vo. Vienne, 1804

Rare The Paris reprint of 1820 is comparatively common

—— *Mémoires Récréatifs, Scientifiques, et Anecdotiques du Physicien-Aéronaute.* Plates. 2 vols. 8vo. 1831

SALLE. *Moyen de diriger l'Aérostat, avec un Précis Historique des démarches que l'Auteur a faites.* 96 pp. 5 plates. 8vo. Pékin et Paris, 1784

SANSON (A. J.). *Navigation dans l'Air. Le Point d'appui Aérien applicable à l'Aérostation.* Folding frontispiece of the author's ' Navire Aérien dirigeable '. 31 pp. 8vo. 1841

—— *Les Vrais Principes de la Navigation Aérienne : ou l'Énigme de l'année 1839 dévoilée.* Par Sanson père et fils. 16 pp. 1852

SCOTT (Le Baron). *Aérostat Dirigeable à Volonté.* 160 pp. 2 plates. 8vo. 1789

STURM (J. C.). *Collegium Experimentale, sive Curiosum.* Engravings. 2 vols. Sm. 4to. Norimbergæ, 1676–85

Tentamen X (vol. i, p. 56) consists of an explanation of Lana's 'Flying Boat', with an engraving of the same on p. 64. It is of interest to note that Fig. xl (p. 56) illustrates an experiment with globes floating in water and thereby sustaining a boat-shaped vessel. At the end of the volume (Appendix, p. 96) there is a Latin translation of Ch. VI of the *Prodromo.*

TISSANDIER (G.). *Les Ballons Dirigeables. Expériences de Henri Giffard et Dupuy de Lôme.* 60 pp. Sm. 8vo. 1872

—— *Le Grand Ballon Captif à vapeur de M. Henry Giffard.* 67 pp. Plates. 1878

VERANZIO (Fausto). *Machinae Novae Fausti Veranzi* (text in Latin, Italian, Spanish, French, and German, but only the two latter versions extant). Plates. Folio. [Venezia, ca. 1595]

Plate 38, 'Homo Volans,' depicts a man descending from a tower by means of a parachute device. Very rare. See I.L.A. no. 948.

VINCI (Leonardo da). *Codice sul Volo degli Uccelli e varie altre materie, pubblicato da T. Sabachnikoff, trascrizioni e note di Gio. Piumati, traduzione in lingua Francese di C. Ravaisson-Mollien.* Paris, 1893

The best account of Leonardo's writings on aeronautics is that by Ivor B. Hart, comprised in two articles on 'Leonardo da Vinci as a Pioneer of Aviation,' and on the Manuscript on the Flight of Birds, the latter translated into English (with reproductions of the sketches) for the first time. See *Journal of the Royal Aeronaut. Soc.*, vol. 27, 1923, pp. 244–69 and 289–317.

ZAMBECCARI (Count F.). *Saggio sopra la Teoria e Practica delle Macchine Aereostatiche del C[ittadino] F[rancesco] Z[ambeccari].* 4to. 14 pp. Bologna, 1800

Reprinted, 4to, 8 pp., Venezia, 1803.

—— *Descrizione della Macchina Aerostatica . . . Destinata a tentare il regolamento della medesima per l'Atmosfera.* 8vo. 32 pp. Plates. Bologna, 1803

Reprinted. 4to, 8 pp, plates, Venezia, 1803. For other pamphlets on Zambeccari's exploits, see Boffito's *Bibliography*, pp. 24–5.

CHAPTER I

LEGEND, APOCRYPHAL FLIGHT, AND ROMANCE

BOWMAN. *The Travels of Hildebrand Bowman into Carnovirria, the powerful Kingdom of Luxovolupto, Written by Himself.* Plate. 8vo. 1778

BRUNT (Capt. S., pseud.). *A Voyage to Cacklogallinia.* Frontispiece. 8vo. 1727

The 'Journey to the Moon' is related on pp. 122–67.

[Cambridge (R. Owen).] *The Scribleriad: an Heroic Poem, in six books.* 7 plates. 4to. 1751

The 'flying contest' is described in Book IV, pp. 15–16, with an accompanying plate by L. P. Boitard. The lines were reprinted (with a reproduction of the plate) in *An Aerial Race, &c.*, edited by H C. Levis, privately printed (100 copies, 4to) at the Chiswick Press, 1918.

Cyrano de Bergerac. *The Comical History of the Empires of the Worlds in the Moon and Sun.* Newly Englished by A. Lovell. Frontispiece. 8vo. 1687

The original French versions appeared in 1657 and 1662. The first English translation was made by T. St. Serf in 1659 ; a later one by S. Derrick was published in 1753. A new unexpurgated translation by R. Aldington, G. Routledge [1923], contains an Introduction, and extracts from Godwin, &c.

Dunbar (W.). *Poetical Works.* Edited, with introductions and notes [including an interesting account of Damian's flying and other ventures], by J. Schipper. 4to. Vienna, 1892

There are numerous English editions of Dunbar, e. g. by D. Laing, 2 vols , 1834, and by H. B. Baildon, Cambridge, 1907. In the latter the two satires on Damian are numbered 36 and 37.

[Godwin (F., Bp. of Hereford).] *The Man in the Moone: Or, A Discourse of a Voyage thither.* By Domingo Gonsales. 3 plates. 12mo. 1638

First Edition, very rare. Reprinted (Second Edition) 1657 and 1688, also in Burton (R.), *The English Acquisitions in Guinea, &c.*, 1686 (p. 69 *et seq.*) and 1728 (pp. 63–104). A revised version, with additions, was published under the title of *The Strange Voyage and Adventures of Domingo Gonsales, to the World in the Moon*, frontispiece, 8vo, J. Lever, 1768. French translations appeared in 1648, 1651, 1666, 1671 (with a frontispiece), 1678, &c., and in Dutch, La Haye, 1651, 1671, and Amsterdam (5th Edition).

Johnson (S.). *The Prince of Abissinia* [*Rasselas*], *A Tale.* 2 vols. 12mo. 1759

First Edition, rare. The 'Dissertation on the Art of Flying' forms Ch. XI. Frequently reprinted separately (some illustrated editions depict the 'artist' and his wings) and in editions of the Works.

Lesley (J., Bp. of Ross). *History of Scotland.* [Written 1568–70.] Bannatyne Club, 1830

Records the story of Damian, the Abbot of Tungland (p. 76). This Scottish version was first printed in this edition. The enlarged and revised Latin edition was originally published at Rome, 1578.

Mirror for Magistrates, in 5 parts [the text of 1587, collated with the other editions]. Edited by J. Haslewood. 3 vols. 4to. 1815

The original edition of the first part of *A Myrroure for Magistrates* appeared in 1559, and was followed by two additional parts, as well as re-written and enlarged editions, that of 1610 being the final complete one. The story of King Bladud as revealed in literature has been fully dealt with by Levis (H. C.), *The British King who tried to Fly*, 4to, privately printed (100 copies), 1919.

MORRIS (Rev. Ralph). *Narrative of the Life and Astonishing Adventures of John Daniel, a smith, at Royston in Hertfordshire.* 12mo. 1751

Rare. A Second Edition (in which the author's name is omitted), 1770. The 'flying' incidents were reprinted under the title of *Flying and no Failure ! or Aerial Transit accomplished more than a Century ago*, 16 ll., 8vo, printed by Charles Clark at his Private Press, Totham, 1848.

[PALTOCK (R.).] *The Life and Adventures of Peter Wilkins.* 6 plates by Boitard. 2 vols. 12mo. 1751

The rare First Edition, some copies of which are said to be dated 1750. Reprinted Dublin, 1751, a new edition, 1783, also 1816, with plates by Stothard, and 1822, 12mo, with frontispiece and vignette title. The best modern reprint is that edited by A. H. Bullen, with the original plates reproduced, 2 vols., 1884. A French translation (by P. F. de Puisieux) appeared under the title of *Les Hommes Volants, ou les Aventures de Pierre Wilkins*, plates, 3 vols., Londres et Paris, 1763, and one in German in 1767. *The Unrivalled Adventures of that great aeronaut, or Glum Peter Wilkins*, frontispiece, 1802, is presumably a spurious version.

WILLIAM OF MALMESBURY. *Gesta Regum Anglorum* (finished in 1125). Lib. II, c. 225. Rolls Series

The passage describing the alleged flight of Oliver of Malmesbury (here spelt Eilmer, a Latinized form of the English name Aethelmær) occurs in Lib. II, c. 225. There is (*inter alia*) an English translation by J. A. Giles, Bohn's Antiquarian Library, 1847.

CHAPTER II

EARLY SCIENTIFIC SPECULATIONS

BACON (F., Baron Verulam). *Sylva Sylvarum : or A Natural History, in Ten Centuries.* Published by W. Rawley. Portrait. Folio. 1627

Century VIII includes the 'Experiment solitary touching the flying of unequal bodies in the air (No. 791), and Century IX the 'Experiment solitary touching flying in the air' (No. 886). See Works by Spedding, Ellis, and Heath, vol. ii, 1857, pp. 596 and 634.

BACON (Roger). *De mirabili potestate Artis et Naturæ, &c.* [written ca. 1250]. 4to. Paris, 1542

Containing the references to flying in Chap. IV. First Edition, frequently reprinted. The tract is given in the appendix to the *Opera Inedita* by J. S. Brewer, 1859. It was first translated into English (from the French translation) in *The Mirror of Alchimy*, 1597, and again as *The Discovery of the Miracles of Art, Nature and Magick . . . out of Dr. Dee's own copy*, by T. M. in 1659. There are contemporary *MSS.* in the British Museum and the Bodleian.

BOYATUAU (P.). *The Theatre of the World . . . Whereunto is added a Discourse of the Dignity and Excellency of Man.* Translated by G[iles] R[ose]. 12mo. 1679

The Discourse contains a reference to 'The Art of Flying in the Air like Birds', and in connexion therewith Leonardo da Vinci's attempts. An earlier translation by J. Alday appeared about 1567. The original French edition of Boaistuau's *Théâtre du Monde* was published in 1558.

GLANVILL (John). *A Plurality of Worlds.* Written in French [by Fontenelle]. Translated into English by Mr. Glanvill. 12mo. 1688

Second Edition, 1695. A version by Aphra Behn was also published as *A Discovery of New Worlds*, in 1688. Fontenelle's *Entretiens sur la Pluralité des Mondes* first appeared in 1686. An edition, with notes, by J. De Lalande was published in 1820.

GLANVILL (Joseph). *Scepsis Scientifica: or Confest Ignorance, the Way to Science.* Sm. 4to. 1665

Contains the passage (usually ascribed to Wilkins) prophetically comparing 'a pair of wings' with 'a pair of boots'. Reprinted, with an essay by John Owen, 1885.

HOOKE (R.). *Philosophical Collections.* Plates. 7 numbers. Sm. 4to. 1679, &c.

Number 1 contains the account of Besnier and the first English translation of Ch. VI ('La Nave Volante') from Lana's *Prodromo*, 1670. Reprinted in '*Five Curious and Interesting Papers, particularly the First, Fourth and Fifth*' [the two latter being those on Besnier and Lana], plates, sm. 4to, Glasgow, 1807. See also *Journal Oeconomique*, p. 183, 'Maniere de Voler, par le Docteur Hook'.

—— *Posthumous Works*, with Life by R. Waller. Folio. 1705

The Life contains some account of Hooke's experiments in aeronautics.

[WILKINS (J., Bp. of Chester).] *The Discovery of a New World, or, A Discourse tending to prove, That ('tis probable) there may be another Habitable World in the Moon. With a Discourse concerning the possibility of a Passage thither.* The Third Impression, corrected and enlarged. J. Norton, 1640

The *Discovery* was originally published in 1638, but the *Discourse* (an enlargement of brief references to the subject in the first edition) first appeared in the above edition of 1640. Another edition was printed in 1684, and a French translation in 1656.

—— *Mathematical Magick . . . In Two Books [Archimedes: or, Mechanical Powers, and Dædalus: or, Mechanical Motions].* Portrait, engraved plates and woodcuts. 1648

First Edition, rare. Other editions 1680 and (Fourth) 1691, each with a portrait. In the Second Book, chapters vi to viii deal with 'Volante Automata', 'The Art of Flying,' and 'The possibility of a Flying Chariot'.

—— *Mathematical and Philosophical Works.* Portrait, engravings, and woodcuts. 8vo. 1708

First collected edition, including the fifth editions (1707) of both the *Discovery* and *Mathematical Magick*. Another edition in two vols. appeared in 1802.

WILLUGHBY (F.). *Ornithologiæ libri tres, recognovit J. Raius.* Plates. Folio. 1676

Ray published an English translation (with additions) in 1678.

WORCESTER (Marquis of). *A Century of the Names and Scantlings of such Inventions, As at present I can call to mind to have tried, &c.* 24mo. 1663

The rare First Edition. Invention No. 77 deals with flight. Other editions appeared in 1746, 1778, 1825 (with a Memoir by C. F. Partington), &c. It was also reprinted, with a commentary, by Dircks (H.), *Life, Times and Scientific Labours of the Second Marquis of Worcester*, 8vo, 1865.

CHAPTER III

Eighteenth-Century Chemists, &c.

Black (Dr. Joseph). See below under Ramsay (Sir W.).

Cavallo (T.). *The History and Practice of Aerostation.* Title, &c. viii pp., pp. [1]–326, and Index, 4 ll. 2 plates. 8vo. Printed for the Author, 1785

The first scientific treatise in English on aerostation. Translations into French and German were published in Paris and Leipzig respectively in 1786.

—— *Elements of Natural or Experimental Chemistry.* Plates. 4 vols. 8vo. 1803

Volume iv (Part 5, pp. 316–56) contains a section on Aerostation dealing with the discovery and progress of the science. Cavallo's investigations into aeriform fluids were published in his *Treatise on the Nature and Properties of Air*, 1781, and the *Essay on Factitious Airs*, 1798.

Cavendish (H.). *The Scientific Papers of.* Edited, with an Introduction, by Sir E. Thorpe. 2 vols. 8vo. Cambridge, 1921

Priestley (J.). *Experiments and Observations on different kinds of Air.* 6 vols. 8vo. 1774–86

See bibliography to the article on Priestley in the *D.N.B.*, vol. xlvi, p. 375. A French translation of vols. i–iii appeared in Paris.

Ramsay (Sir W.). *Life and Letters of Joseph Black, M.D.* Portraits. 8vo. 1918

CHAPTER IV

Early Aerostatic Experiments

Adams (G.). *Lectures on Natural and Experimental Philosophy.* 5 vols. 1794

The third volume contains a section on Air Balloons. Second Edition, 1799.

Air Balloon (The): Or a Treatise on the Aerostatic Globe . . . The Whole rendered familiar to the plainest Capacity [by Will. Cooke]. 8vo. 36 pp. (including a 'Postscript', pp. 33–6), frontispiece of 'The Air Balloon Ascending'. G. Kearsley, 1783

The First Edition of the first English book on ballooning. Rare. The attribution of authorship as above is taken from a copy of the First Edition formerly in the possession of Isaac Reed (1742–1807). A 'New [second] Edition, Corrected', with an additional Postscript, as well as a Third Edition (a reprint of the preceding with slight differences) appeared before the end of 1783. A Fourth Edition with considerable additions (extending to 40 pp. in all) was printed early in 1784. All four editions had the same frontispiece.

Southern (J.). *A Treatise upon Aerostatic Machines, containing Rules for Calculating their Powers of Ascension . . . Also a Method of Constructing them of any round Form, &c.* 8vo. 36 ll. 2 folding plates. Birmingham, 1785

An early technical treatise on ballooning. Rare. Southern is said to have been an assistant to James Watt.

[TYTLER] (James). *A Biographical Sketch of* [by R. Meek]. 8vo. Edinburgh, 1805

There is a brief account of Tytler in Kay's *Original Portraits*, 2 vols., 1837–8 (No. 38, A Group of Aeronauts).

UNCLES (M.). *Thoughts on the Farther Improvements of Aerostation.* 8vo. 1787

Quoted from Wouvermans, p. 10, but the author has never seen a copy. The title is very similar to the treatise attributed in the present work to S. Hoole (see *post*, under Ch. XIII, p. 410).

[URQUHART (G.).] *Institutes of Hydrostatics . . . [with] a Philosophical Essay on Air-Balloons.* Plates. 8vo. 1786

The Essay on Air-Balloons, with accounts of the earliest ascents, occupies pp. 211–54.

ZAMBECCARI (Count F.). See under General Survey—Scientific and Technical Works (p. 396).

A brief account of Zambeccari's exploits in London is given by Boffito, Ch. XV.

CHAPTER V

VINCENT LUNARDI

Lunardi is included in the *D.N.B.*, though he was only living in England for about five years. For Italian sources of information as to his life see Boffito.

BALDWIN (T.). *Airopaidia: containing the Narrative of a Balloon Excursion from Chester the eighth day of September, 1785 . . . Hints on the Improvements of Balloons,* &c. Half-title, &c., 6 ll. and pp. [1] to 361 (the last misnumbered 360), 4 plates (2 of which are coloured). 8vo. Chester, Printed for the Author, 1786

KAY (J.). *Original Portraits and Caricature Etchings* [with biographical sketches]. 2 vols. 4to. Edinburgh, 1837–8

Includes two etchings (Nos. 36 and 38) of Lunardi ' in his basket, ready to ascend ', and amongst ' A Group of Aeronauts '. See also under TYTLER (J.), Ch. IV.

LUNARDI (Vincent). *A Particular Description of Mr. Lunardi's Aerial Voyage . . . To accompany the Prints of his celebrated Balloon.* 2 ll. 4to. [1784]

—— *Lunardi's Grand Aerostatic Voyage through the Air, Sep. 15, 1784 . . . with a Variety of Particulars that have never yet transpired.* Title and Dedication, 2 ll., pp. 1–15, portrait. 4to. 1784

There is a copy of this rare contemporary account of Lunardi's first ascent in the British Museum. The report Lunardi himself made to the H.A.C. is printed in Major G. A. Raikes's *History of the Regiment*, 1879, vol. 2, p. 108.

—— *Account of the First Aërial Voyage in England, in a Series of Letters to . . . Chevalier Gherardo Compagni.* 8vo. 2 ll., pp. 1–66, portrait by

F. Bartolozzi after R. Cosway, and 2 folding plates of the Balloon, &c. (with a leaf of Explanation). Printed for the Author, 1784

The First Edition, which was issued with the portrait (5*s.*) or without (2*s.* 6*d.*). The half-title usually bears Lunardi's autograph. Reprinted in *Astra Castra*, pp. 56–76.

LUNARDI (Vincent). The same, Second Edition (the same collation). 1784

With slight variations from the foregoing, e. g. p. 35 ' South ' is altered to ' North ' in line 11. The half-title sometimes bears Lunardi's autograph. Reprinted as a Third Edition the same year.

—— *Mr. Lunardi's Account of his Ascension and Aerial Voyage, from the New Fort, Liverpool, on the 20th of July, 1785. In Three Letters to George Biggin, Esq.* 8vo. 21 ll., frontispiece of ' An exact representation of Mr. Lunardi's [Second] Balloon as it ascended with George Biggin and Mrs. Sage ', &c. No imprint, [1785]

The copy in the writer's possession is the only one he has seen with the frontispiece (see Fig. 26), the lettering on which accords with the reference on the title to Biggin having ascended with Mrs. Sage from St. George's Fields.

—— *Mr. Lunardi's Account of his Second Aerial Voyage from Liverpool, on Tuesday the 9th of August, 1785, In Two Letters to George Biggin.* 8vo. 20 ll. No imprint, [1785]

The Liverpool *Voyages* are both very rare—they are seldom mentioned in aeronautical bibliographies. A copy of each appeared in Maggs's *Bibliotheca Aeronautica* (Catalogue, No. 387, 1920), and in the catalogue of Maj. B. F. S. Baden-Powell's collection sold at Hodgson's Auction Rooms, June 29, 1923 (lots 22 and 23).

—— *An Account of Five Aerial Voyages in Scotland in . . . Letters to Chevalier Gerardo Compagni.* 8vo. 4 ll. 114 pp. 2 plates of the Balloon and Apparatus (with leaf of Explanation). Printed for the Author, 1786

Rare. Reprinted in *Astra Castra* (pp. 93–110), but wrongly entitled ' Second Series of Letters '.

—— *Particulars relating to Mr. Lunardi's Improved Aèrostatic Machine, or Aerial Telegraph, exhibited at the Pantheon, Oxford Street.* 4 ll. 12mo. [1805]

From advertisements of 1805 respecting the above, it appears—though the fact is not otherwise noted—that Lunardi (after ' thirty-five aerial voyages ') was in London at this time. Presumably financial difficulties prevented an ascent with this ' superb ' machine made to carry 10 or 12 persons.

SAGE (Mrs. L. A.). *A Letter addressed to a Female Friend.* By Mrs. Sage, The First English Female Aerial Traveller. 16 ll. (text ends at p. 31). 8vo. Printed for the Writer, [1785]

The First Edition of the first narrative of a balloon ascent by an Englishwoman.

—— The same, Second Edition. 16 ll. (text ends on p. 32). 8vo.

There are alterations or corrections from the First Edition on pp. 5, 6, 10, 21, &c. On p. 22 there is an added comment on the effect of ' rarefaction ' of the air on the ears of Biggin, and on pp. 23–4 a new paragraph on experiments made by the latter. The Third Edition, also undated, is a reprint of the Second.

CHAPTER VI

The First English Aeronaut, James Sadler, and his Sons

There is no separate entry in the *D.N.B.* for James Sadler, but some particulars of his life (with a notable error as to the date of his first ascent) are given under the name of his son Windham William (*sic*) Sadler. (See vol. 1, 1897, p. 113). In most aeronautical histories the doings of the father and his two sons are inadequately recorded and generally confused.

[Beaufoy (H.).] *Journal kept by H. B. during an Aerial Voyage with Mr. James Sadler, Sen., from Hackney to East Thorpe, Essex, Aug. 29, 1811.* 39 pp., and folding table (no title). 8vo. G. Woodfall, [1811]

The author was the son of Col. Mark Beaufoy (1764–1827), astronomer, and the first Englishman to climb to the summit of Mont Blanc, who ascended in Graham's balloon in June, 1824. Henry Beaufoy's valuable library (including some books on ballooning, and a collection of aeronautical engravings, &c., lot 228) was sold at Christie's, seven days, commencing June 7, 1909.

Sadler (James). *Balloon. The Only True and Authentic Account of the Voyage from Bristol, Sept. 24, 1810. Taken from the Memoranda of and corrected by the Aeronauts.* 4 ll. 8vo. Bristol [1810]

Rare. This First Edition did not contain the plan as added in the following.

—— *Balloon. An Authentic Account of the Aerial Voyage of Messrs. Sadler and Clayfield.* Second Edition, with Corrections and Additions. 6 ll., and folding plan. 8vo. Ibid. [1810]

—— *Balloon. An Authentic Narrative of the Aerial Voyage of Mr. [James] Sadler, across the Irish Channel, from . . . Dublin, on Oct. 1st, 1812.* 12 ll., and plan of the Balloon's course. 8vo. Dublin, 1812

A poem on this exploit 'founded, almost entirely' on newspaper accounts, was published as *The Aeronaut*, 9 ll. Dublin, 1816.

Sadler (William Windham). *Aerostation. A Narrative of the Aerial Voyage of Mr. Windham Sadler, across the Irish Channel, July 22, 1817.* 13 ll., and plan. 8vo. Ibid., 1817

The plan is the same as that used for the elder Sadler's unsuccessful voyage in 1812, with the course taken by Windham Sadler's balloon added. Both pamphlets are rare.

Windham (W.) Diary, 1784–1810. Edited by Mrs. H. Baring. 8vo. 1866

Letters written by Windham after his ascent with Sadler from Moulsey Hurst are printed in *The Windham Papers*, 2 vols., 1913.

CHAPTER VII

Early Foreign Balloonists in England

The best general accounts of Blanchard are to be found in Lecornu and Tissandier. The sources of information respecting Zambeccari are given in Boffito, but no accounts of his exploits were published in English.

Blanchard (J.-P.). *Journal and Certificates on the Fourth Voyage of Mr. Blanchard, from the Royal Military Academy, at Chelsea, 16th of Oct., 1784 . . . accompanied by John Sheldon.* Title and Dedication (usually signed 'Blanchard'), 2 ll., pp. 1–29. 4to. 1784

COUTIL (L.). *Jean-Pierre Blanchard, Physicien-Aéronaute. Biographie et Iconographie.* Plates. 8vo. Évreux, 1911

Besides the list of engravings there is a bibliography, but neither is complete as to English entries. The monograph also records the aeronautical exploits of Mdme Blanchard (*née* Marie Armant, 1778–1819), killed in Paris through her balloon catching fire.

JEFFRIES (J.). *A Narrative of the Two Aerial Voyages of Doctor Jeffries with Mons. Blanchard, The First . . . on the Thirtieth of November, 1784, from London into Kent: The Second, on the Seventh of January, 1785, from England into France.* Title and 60 pp. Portrait of Jeffries by Caroline Watson after J. Russell, and plate at end. 4to. 1786

POTAIN (Dr.). *Relation Aérostatique* [*June 17, 1785*], *dédiée à la Nation Irlandaise.* Portrait. 4to. 1824

ZAMBECCARI (Count F.). See under General Survey (p. 396), and Ch. IV.

CHAPTER VIII

BRITISH AERONAUTS PRIOR TO 1800

The usual works of reference contain very little matter relating to the aeronauts dealt with in this chapter. Major Money alone appears in the *D.N.B.*, 1894 (vol. xxxviii, p. 173). The chief sources of information have been the Cuthbert and Patent Office Collections.

DEEKER (J.). *An Account of Mr. James Deeker's Two Aerial Expeditions from the City of Norwich, June 1, and 22, 1785* [by Edward Rigby]. Title and Advertisement, 4 ll., pp. 1–50, with frontispiece by Neele. 8vo. Norwich, J. Crouse, 1785

HARPER. *The Ballooniad.* In two Cantos, 8 ll. Birmingham, 1785, and Canto the Third, 4 ll. (no imprint)

Burlesque descriptions of Harper's ascents from Birmingham in Jan. 1785. See Ch. VIII, p. 193 *ante.*

LOCKWOOD (J.). *Account of his Aerial Excursion* [*in June, 1785*] *. . . with the British Balloon, accompanied by Major Money and Geo. Blake.* 4 pp. 8vo. 1785

MONEY (Major-Genl. J.). *A Short Treatise on the Use of Balloons and Field Observations in Military Operations.* 10 ll., and 2 folding plates. 4to. T. Egerton, 1803

CHAPTER IX

THE BALLOON IN LITERATURE, CARICATURE, &c.

COWPER (W.). *Correspondence*, arranged in chronological order by T. W. Wright. 4 vols. 8vo. 1904

JOHNSON (S.). *Life*, by James Boswell, edited by G. Birkbeck Hill. 6 vols. Oxford, 1887

JOHNSON (S.). *Letters*, edited by G. Birkbeck Hill. 2 vols. Ibid., 1892

See also an article on 'Johnson on Ballooning and Flight' in the *London Mercury*, vol. 10, 1924, p. 63.

WALPOLE (Horace). *Letters*, chronologically arranged, with notes, by Mrs. Paget Toynbee. 16 vols. 8vo. Oxford, 1903–5

The letters containing references to balloons (the notes as to which are not wholly reliable) are mostly in vol. xiii.

IMAGINATIVE WORKS, POEMS, &c.

Aeronaut (The), A Poem, founded, almost entirely, upon a statement (Printed in the Newspapers) of a Voyage from Dublin in Oct. 1812. 9 ll. 8vo. Dublin, 1816

Balloon (The), or Aerostatic Spy, a Novel, containing a series of Adventures of an Aerial Traveller. 2 vols. 12mo, with a frontispiece of 'Lunardi's Grand Air Balloon, engraved for the Aerostatic Spy, April 1st, 1785'. 1786

CROSBIE (R.). *To Richard Crosbie, on attempting a second Aerial Excursion, May 12, 1785.* Broadside in verse, with descriptive foot-note. Dublin, 1785

Reprinted in *A Collection of Poems*, by S White, 1792, p 195.

DARWIN (E.). *The Botanic Garden, A Poem, in Two Parts.* Plates. 4to. 1791

The lines on flight appear (Third Edition, 1795) in Part 1, Canto 4, 143–164, and Part 2, Canto 2, 25–66.

GREEN (C.). *High and Low, or Mr. Green among the Stars.* 4 ll. 8vo. Oxford, 1824

HOOD (T.). *Poems* [including the 'Ode to Mr. Graham the Aeronaut' and 'A Flying Visit'], edited by A. Ainger. 2 vols. 1897

IRELAND (W. H.). *Rhapsodies* [including a Poem on air-balloons]. 8vo. 1803

MEDLEY (Rev. R. S.). *The Air Balloon Spiritualized.* 8 ll. Sm. 8vo, L. I. Higham (Price Three-Halfpence). 1823

Modern Atlantis (The); or, The Devil in an Air Balloon. 125 pp. 8vo. G. Kearsley, 1784

A volume of scurrilous and anonymous 'secret memoirs of Persons of High Quality in the Island of Libertusia', the 'Air Balloon' being merely introduced on the title as a topical subject—as in *The Balloon or Aerostatic Spy* above.

Mogul Tale (The); or, The Descent of the Balloon, A Farce. As it is acted at the Theatre-Royal, Smoke-Alley. 11 ll. Sm. 8vo. 1788

PALTOCK (R.). *Peter Wilkins. A Melo-Dramatic Spectacle* [acted at Covent Garden Theatre]. 1827

A type of various productions of a similar kind. E. L. L. Blanchard wrote a pantomime on the subject of 'Peter Wilkins' for Drury Lane in 1860.

PILON (F.). *Aerostation: or, The Templar's Stratagem. A Farce in Two Acts.* 8vo. 1784

[PYE (H. J.).] *Aerophorion. A Poem* [on James Sadler's Ascent from Oxford, Nov., 1784]. 6 ll. 4to. Oxford, 1784

Reprinted in Pye's *Poems on Various Subjects*, 2 vols., 1787.

[RASPE (R. E.).] *The Surprising Adventures of Baron Munchausen.* Plates. 12mo. G. Kearsley, 1787

The chapters added by Kearsley to Rapse's original work, contained topical allusions to balloon ascents by Montgolfier and Lunardi. The illustrations (notably those by Rowlandson and Cruikshank) in the numerous later editions usually depict the Baron's flying and ballooning exploits.

SCOTT (Andrew). *Poems on Various Occasions.* 8vo. Edinburgh, 1826

Symposia . . . containing Balloon Intelligence for 1785, 1786, 1787. 1787

Purely imaginary notions of conceivable (and inconceivable) uses for the balloon.

[THACKERAY (W. M.).] *The Snob.* 11 nos. 12mo. Cambridge, 1829

No. 7 contains a dramatic sketch entitled *The Veteran Aeronaut, or Mr. Green.*

VIVENAIR (Mons., pseud.). *A Journey lately performed through the Air, in an Aerostatic Globe . . . To the newly discovered Planet, Georgium Sidus.* Translated from the French. 41 pp., and frontispiece. 8vo. 1784

Another topical production, in which the balloon figures in a minimum degree.

CHAPTER X

BALLOONING FROM 1800 TO 1850

Accounts of Garnerin's aeronautical career are given in Tissandier and Lecornu. Garnerin's exploits in London in 1802 called forth several small volumes on aerostation, a few of which are quoted below. The sources of information respecting the Grahams, Hampton, Gypson, and the rest, are mainly the newspapers and engravings of the day. There is an account of Gale in the *D.N.B.*, vol. xx, 1889, p. 373, and some details of his career are to be found in Sala (G. A.), *Life*, 1896, pp. 236–9.

Aeronautica, or Voyages in the Air . . . with all those performed in England from Lunardi's, including those by M. Garnerin. 72 pp. (including title, &c.), with coloured folding frontispiece. Sm. 8vo. V. Griffiths [1802]

Aerostatics, or A History of Balloons [including the Voyages of Lunardi, Sadler, Garnerin, Crosbie, Maguire (*sic*)], 55 pp. (including title), coloured frontispiece of Garnerin's balloon and parachute. 55 pp. Sm. 8vo. 1802

Aerostation Displayed, containing . . . the most celebrated Aerial Voyages [including those of Lunardi, Arnold, Zambecarri (*sic*), Deeker, Blanchard, Garnerin, &c.] title, &c., 2 ll., and pp. 1–56, with coloured frontispiece of Garnerin's balloon, and plate of apparatus. 8vo. J. Hammond [1802]

BEAUFOY (Mark). *An Account of some Observations made during a late Aerial Excursion* [with Graham from Conduit House, Islington, June 17, 1824], 4 pp. 8vo. (Reprinted from the *Annals of Philosophy*.) 1824

Flights in the Air: being an Historical Account of the most Remarkable Aerial Voyages performed in France, Germany, Great Britain and Ireland, &c. . . . with the ascensions of M. Garnerin. Plate. 12mo. 1802

GARNERIN (A.-J.). *An Account of Two Aerial Voyages made by M. Garnerin, June 28th and July 5th, 1802 . . . With a sketch of the Life of M. Garnerin.* 37 pp. 12mo. [1802]

—— *A Circumstantial Account of the Three last Aerial Voyages made by M. Garnerin, Aug. 5, Sep. 7, and 21, 1802, including the Interesting Particulars communicated by Himself.* Coloured frontispiece by Von Assen. 36 pp. Sm. 8vo. A. Neil [1802]

HAMPTON (J.). *The Aerial Messenger . . .* [for May, June and July]. 24 mo, each 4 ll., the last printed in gold on black paper.
Printed at the Aerial Press in the Isle of Sky, 1839

This miniature aeronautical journal contained in fact little more than advertisements of Hampton's own exploits. It was revived in May, 1853 (vol. 1, no. 1, 16 pp.).

STARK (W.). *A Letter to John Harvey Esq., containing an Examination of . . . 'Mrs. Graham's Statement of Facts' relative to the Balloon.* 29 pp. 8vo.
Norwich [1825]

CHAPTER XI

CHARLES GREEN

Charles Green is included in the *D.N.B.*, vol. xxiii, 1890, p. 40. The Cuthbert Collection comprises a quarto volume of news-cuttings recording his ballooning exploits, and a large collection of posters and hand-bills of his ascents ranging from the first (July 18, postponed to Aug. 8, 1821) to the 500th (Sept. 8, 1852).

GREEN (C.). *Authentic Narrative of the Great Balloon Voyage and Descent in Germany (Mr. Green's own Account).* Woodcut on title. 4 ll. 8vo.
W. Marshall (Price one Penny) [1836]

—— *Ausfuhrlicher Bericht meiner Luftfahrt von London über den Kanal, &c.* 7. Nov. 1836, aus dem Englischen. 46 pp. Plate. 8vo.
Grimma, 1837

MASON (T. Monck). *Account of the late Aeronautical Expedition from London to Weilburg.* 52 pp. 8vo. 1836

A French translation was published in Paris the same year. The MS. Journal (12 pp.) of the voyage written in the balloon by Robert Hollond, appeared in Messrs. Maggs's catalogue, No. 435, 1923 (*Bibliotheca Aëronautica*, Part 2, No. 953).

—— *Aeronautica; or, Sketches illustrative of the Theory and Practice of Aerostation, comprising an Enlarged Account of the Aerial Expedition to Germany.* vii and 355 pp., with 5 litho plates. 8vo. 1838

Appendix C (pp. 245–90) comprises a list of aeronauts, with brief memoirs of the more important names. The list was based on an earlier one compiled by Dupuis-Delcourt (see *Essai sur la Navigation dans l'air*, 1830), who reprinted Monck Mason's enlarged list (but without the biographical notes) in his *Manuel d'Aérostation*, 1850. It was also printed in *Astra Castra*.

POOLE (J.). *Crotchets in the Air; or, An (Un)scientific Account of a Balloon-Trip* [with C. Green, Sept. 14, 1838]. Title and pp. 1–98. 8vo. 1838

A Second Edition appeared with the same date. Reprinted in *Astra Castra* (pp. 399–414), by Hatton Turnor, who expressed regret at being unable to discover 'the name of the author'.

RUSH (G.). *An Account of Ascents in the Nassau and Victoria Balloons, in 1838, 1849, and 1850.* Title, &c., 2 ll., pp. 1–36, with frontispiece. 1851

CHAPTER XII

THE DECLINE OF THE FREE BALLOON, AND THE DEVELOPMENT OF AERONAUTICAL SCIENCE

Aeronautical Society of Great Britain—Annual Reports. First [Aerial Locomotion, by F. H. Wenham] to Twenty-third, issued in blue wrappers. Sm. 8vo. 1866–93.

See Appendix II for list of papers printed in the above.

Aeronautical Society of Great Britain—Catalogue of the First Exhibition of the Aeronautical Society of Great Britain [held at the Crystal Palace, Sydenham, June 25th, 1868, and 10 following days]. 23 pp. 8vo. [1868]

A report on this exhibition, with the prize awards, was appended to the Society's Third Annual Report for 1868.

Aeronautical Society of Great Britain—Aeronautical Exhibition, under the Patronage of the Aeronautical Society of Great Britain, at the Alexandra Palace, June, 1885 [an explanatory pamphlet], 8 pp. 12mo. [1885]

A Juror's Report (26 pp.) on the 16 exhibits was subsequently published by the Society. It was drawn up by E. A. Barry, one of the jurors, the others being Prof. H. S. Hele Shaw and H. Tingle.

Aeronautical Society of Great Britain, Founded 1866 [A Brief Account of, by A. E. Berriman]. 52 pp. Plates. Sm. 4to. [1912]

BREAREY (F. W.). *Some Observations upon the Possible Attainment of Aerial Flight.* 8 pp. 8vo. Greenwich, n.d.

—— Paper read by F. W. Brearey, at Stafford House, Feb. 28, 1866. 4 pp. 8vo. Wrapper. W. Holmes, 1866

Explaining the objects of the Aeronautical Society, of which this was the first publication. For other papers by Brearey, see Appendix II.

COXWELL (H.). *Balloon (The), or Aerostatic Magazine*, edited by Henry Coxwell, vol. i (all published), title, &c., 4 ll., pp. 1–96, folding frontispiece and woodcuts. 8vo. B. Steill, 1845

Issued as four numbers in pink wrappers, the first no. 'Edited by H. Wells' (pseud. for H. Coxwell). A supplement of 8 pp., with an Account of the Bursting of Gypson's Balloon, July 6, 1847, &c., was published by Coxwell after the event.

COXWELL (H.). *Aerostatic Magazine (The)*, portrait of Coxwell (from the *Illustrated German News*, Oct., 1851), 24 pp. (with a new cover). [1859]

—— *Aerostatic Magazine (The)*. 24 pp. 8vo, green wrapper. 1869

Between the irregular issue of the foregoing, two nos. of the *Antiquarian and Aerostatic Miscellany* were printed by F. W. Wheeler in Feb. and Mar. 1855, but presumably Coxwell had no connexion with this publication.

—— *Balloons for Warfare. A Dialogue between an Aeronaut and a General.* 8 pp. 8vo, green wrapper. Tottenham [1854]

In England it was not until 1896 that a *Manual of Military Ballooning* [compiled by Capt. B. R. Ward] was issued from the School of Ballooning, Aldershot, for service use. A revised edition, Part I, was printed in 1906.

—— *My Life and Balloon Experiences, with a Supplementary Chapter on Military Ballooning.* [First Series], photo portrait, 1887, and Second Series. Illustrations, 1889. 1887–9

GLAISHER (J.). *Travels in the Air, by James Glaisher, C. Flammarion, W. de Fonvielle, and Gaston Tissandier.* 118 illustrations. Plates. 414 pp. 8vo. 1871

Originally published in French, under the title of *Voyages Aériens*, 1870.

—— The same, Second and Revised Edition [with a Preface, and List of the Siege of Paris balloons]. 125 illustrations, with the addition of 6 chromolithographs. 398 pp. Roy. 8vo. 1871

A German translation by H. Masius was printed at Leipzig in 1872. Also translated into Russian.

—— *Account of Meteorological and Physical Observations* [made for the British Association, from the Report for 1862]. Title and pp. 376–503. 8vo. 1863

—— *Scientific Experiments in Balloons* [Exeter Hall Lecture]. 50 pp. Diagrams. 12mo. 1863

CHAPTER XIII

EARLY ATTEMPTS TO CONTROL BALLOONS, AND THE DEVELOPMENT OF THE AIRSHIP

For general sources of information see Ch. I, but the evolution of the airship has nowhere been adequately dealt with on historical lines of evolution.

Aeronautical Society of Great Britain, Annual Reports—see under Ch. XII.

BRANNON (P.). *The Air-Boat for Arcustatic Air-Travel, dispensing with the use of Gas, Hydrogen, Hot or Vapor Air Balloons,* &c. Woodcuts. 56 pp. 8vo. 1879

The author was a civil and sanitary engineer, the above pamphlet containing an abstract of 192 ' Brannon Inventions ', Class XXII dealing with a ' Levitation

Air Ship' (Patent No. 3272, 1870), and XXIII with 'Arcustatic or Arc-Aero Navigation' (Patent No. 3974, 1877): it also contains an announcement of eight public lectures on the 'Navigation of the Atmosphere', at the last of which (June 7, 1879) Major B. F. S. Baden-Powell was the only person present!

BREWER (Griffith), and P. Y. ALEXANDER. *Aeronautics: An Abridgment of Aeronautical Specifications filed at the Patent Office, 1815–91.* Illustrations. 8vo. 1893

See also under Patent Office.

CAYLEY (Sir G.). *On Aërial Navigation [Navigable Balloons]*, in Tilloch's *Philosophical Magazine*, vol. 47, 1816, pp. 81–6 and 321–9, also vol. 50, 1817, pp. 27–35. 1816–17

—— *Practical Remarks on Aerial Navigation [Navigable Balloons]*, 8 ll. (pp. 7–16, and 3 woodcut illustrations), 8vo (reprinted from the *Mechanics' Magazine*, vol. 26, 1837, pp. 418–28). [1837]

Reprinted in *Aeronautics*, vol. ii, 1909, p. 142, and vol. iii, 1910, p. 1. 'Some Notes on Sir George Cayley as a Pioneer of Aeronautics' (by the present writer) is an attempt to deal with Cayley's aeronautical work in general. (See *Newcomen Society's Transactions*, vol. iii, 1924.)

[DEVERELL (R.).] *Alter et Idem, A New Review.* No. 1, title, &c., 3 ll., and 119 pp., with 3 plates (not aeronautical). 4to. Reading, 1794

Article 2 (pp. 11–18) deals with 'A Project for Directing an Air-Balloon' by the explosive force of rockets.

[HOOLE (Samuel).] *Thoughts on the Farther Improvement of Aerostation . . . With a Description of a Machine now constructing . . . By the Inventor of the Machine.* Half-title, title, and 32 pp. 8vo. Printed for the Author. 1785

See note as to authorship at p. 295 of the present work.

LENNOX (Count). *A Full and Correct Description of the Extraordinary Machine, the first Aerial Ship, The Eagle.* 2 ll., and folding coloured woodcut. 8vo. J. Thompson, 1835

The title is misleading, as the leaflet contains but scant details. There are several communications on the project, explanatory and critical, in the *Mechanics' Mag.*, vol. 23, 1835. 'The Eagle' was the subject of several broadside songs and humorous illustrations. 'The Aerial Ship' was the title of a 'comic ballad', set to music by R. Evans, which had a lithographic caricature on the cover. (Fig. 66.)

LUNTLEY (J.). *Air-Navigation, by means of the Rotary Balloon.* 20 pp. Plate. 8vo. 1851

MACSWEENY (J.). *Essay on Aerial Navigation.* Cork, 1824

First Edition, very rare.

—— *An Essay on Aerial Navigation, pointing out Modes of Directing Balloons.* Second Edition, revised. Title, &c., 4 ll., and 122 pp., 3 plates. Sm. 8vo. Cork, 1844

Issued in a pink wrapper, on which the title is repeated. Copies not infrequently bear presentation inscriptions. There is a useful bibliography at p. 83.

MANSFIELD (C. B.). *Aerial Navigation* [written in 1851], edited by R. B. Mansfield. Diagrams. 537 pp. 8vo. 1877

MARTYN (Thomas). *Hints of Important Uses to be derived from Aerostatic Globes, With a Print of an Aerostatic Globe, and its Appendages. Originally designed in 1783.* Title, &c., 2 ll., and 16 pp., folding plate. 4to. Printed for the Author. 1784

The aeronautical collection of Major B. F. S. Baden-Powell, F R.A.S , included a copy of the above printed on large paper, the full size of the plate. In the author's small paper copy the plate is coloured. Rare, especially so on large paper.

MASON (T. Monck). *Remarks on the Ellipsoidal Balloon propelled by the Archimedean Screw,* &c. 24 pp. 8vo. [1843]

Mechanics' Magazine (The), from 1823 to 1858, 69 vols., continued from 1858 to 1872 by a New Series, 28 vols. 1823–72

The above journal—of a popular character—published many contributions on aeronautics, including a reprint of Walker's *Treatise upon the Art of Flying*, 1810, and articles by Sir George Cayley.

NYE (J.). *Thoughts on Aerial Travelling and the Best Means of Propelling Balloons.* 21 pp. Frontispiece. 8vo. 1852

Patents—Abridgments of Specifications relating to Aeronautics, A. D. 1816–1866 [compiled by W. H. Walenn]. 1869

Patents—Abridgments for Specifications. Class 4, Aeronautics, from 1855 onwards. Diagrams. Roy. 8vo. H.M. Stationery Office, 1905, &c.

POLE (W.). *A Study of the Problem of Aerial Navigation* [Dirigible Balloons]. 28 pp., 1882, and Further Data, 10 pp., 1885. 1882–5

Reprinted from the *Proceedings of the Civil Engineers*, vols. lxvii, pt. 1 and lxxxi, pt. 3. Pole (who was a F.R S.) was the author of an article in the *Quarterly Review* for July, 1875.

WHALE (G.). *British Airships, Past, Present, and Future.* Plates. Cr. 8vo. 1920

CHAPTER XIV

THE INVENTION AND DEVELOPMENT OF THE PARACHUTE

The history of the parachute does not appear to have been treated anywhere at length. There is a short chapter in La Landelle, but otherwise references to its use by Lenormand, Blanchard, Garnerin, &c., are scattered through various histories and encyclopaedias. Of Cocking's failure far too much has been written, whereas Hampton's descents are seldom recorded elsewhere than in contemporary papers. There is no technical treatise in English devoted to the parachute, and the article in the *Ency. Brit.*, Eleventh Edition, is quite inadequate. A paper on the subject (with brief references to past history) was read before the Aeronautical Society by Major T. Orde Lees in March, 1921 (see *Aeronaut. Journal*, vol. xxv, 1921, p 317).

FALKENBERG (Gustav von). *Der Fallschirm, seine geschichtliche Entwicklung und sein technisches Problem.* Plates. 8vo. 1912

The only separate treatise on Parachutes, in which the historical aspects are fully treated

GARNERIN (A.-J.). See under Ch. X, p. 406.

LENORMAND (S.). 'L'Invention des Parachutes', in *Annales de Chimie*, vol. xxxvi.

VERANZIO (F.). *Machinae Novae.* 49 plates. Folio. [1595]

See also under General Survey, p. 396. The plate 'Homo Volans' is No. 38. It was reproduced by Hatton Turnor (p. xiii) and Bruel, No. 179.

VINCI (Leonardo da). *Saggio delle . . . di Leonardo da Vinci* [facsimile reproductions from the Codex Atlanticus]. Milano, G. Ricordi, 1872

The small sketch of a parachute, with the accompanying text (translated), is given by Hart (Ivor B.) in his paper on Leonardo da Vinci as a Pioneer of Aviation (*Journal of the Royal Aeronaut Soc.*, vol. xxix, 1923, pp. 247–8).

CHAPTER XV

THE EVOLUTION OF HEAVIER-THAN-AIR FLIGHT

The most comprehensive and authoritative treatise on the evolution of mechanical flight in all countries is undoubtedly that of Chanute (Octave), *Progress in Flying Machines*, New York [1894].

BREWER (Griffith), and P. Y. ALEXANDER. See under Ch. XIII, p. 409.

CAYLEY (Sir G.). 'On Aerial Navigation' [Mechanical Flight] in *Nicholson's Journal of Philosophy*, vol. xxiv, pp. 164–74, and vol. xxv, pp. 81–7 and 161–9. 1809–10

Reprinted in the Aeronautical Society's Report for 1876, again as Aeronautical Classics, No. 1, 1910; and in Means's *Aeronautical Annual* for 1895. See also under Ch. XIII.

—— 'On the Principles of Aerial Navigation' [Mechanical Flight], in the *Mechanics' Magazine*, vol. xxxviii, pp. 273–8, with diagrams. 1843

The same volume also contains (p. 263) a letter from Cayley appended to the article on Henson's Aerial Carriage. His last contribution to this magazine was an essay on 'Governable Parachutes' (gliders) in vol. 57, 1852, p. 242.

—— 'Mémoire sur le Vol Artificiel', in the *Société Aérostatique et Météorologique de France, Bulletin* No. 4, pp. 147–51. 1853

HAMILTON (C. C.). *An Essay on the Art of Flying, with an Indication of the Materials best adapted for Wings* (Date, 1839). 8vo. 1841

A Second Edition, 15 pp, 8vo, was published in 1842. The essay is mainly concerned with vague notions on the making of wings for human flight, in the construction of which the author laid down the axiom that 'materials have been the sole desiderata'. His futile solution lay in india-rubber and metallic springs.

HARDINGHAM (G. G. M.). *Practical Aeronautics* [ornithopter machine, wings actuated by steam or explosion engine]. 24 pp. 2 plates. 1871

HARTE (R.). *A Theory of Flight: Being a Popular Exposition of Some Fundamental Laws of Aerial Locomotion.* 24 pp. Printed for Private Circulation [1870]

The author took out a patent for his machine (No. 1469, May 21, 1870).

HENSON (W. S.). *The Full Particulars of the Aerial Steam Carriage (By Authority).* 8 pp., with woodcut. 8vo. T. Goode [1843]

Perhaps the best technical account of Henson's machine as designed is that in the *Mechanics' Mag.*, vol. 38, 1843, p. 258. See also the patent specification (with plans) No. 9478, 1842.

—— See also STRINGFELLOW (J.).

[LUNTLEY (J.).] *Aerial Navigation; Containing a Description of a Proposed Flying Machine on a New Principle.* By Daedalus Britannicus, with Appendix (being a review of Henson's 'Ariel', from the *Athenaeum*, Apl. 8, 1843). 8 ll. Frontispiece. 8vo. 1847

MOAT (W. C.). *Steam Flying Machines.* 8 pp. (the first page—there is no title—being a woodcut). Sm. 8vo. [1853]

MURRAY (G.). *Aerial Locomotion: A Descriptive Treatise of a Practical Method of Traversing the Atmosphere.* 9 plates. 36 pp. Liverpool [1883]

Patents. See under Ch. XIII, p. 411.

PETTIGREW (J. Bell). See under General Survey: Scientific and Technical Works.

STRINGFELLOW (F. J.). *A Few Remarks on what has been done with Screw-Propelled Aero-plane Machines, from 1809 to 1892.* 14 pp., with 6 photos of John Stringfellow's models, &c. 8vo. Chard [1892]

STRINGFELLOW (J.). *The Aeronautical Work of John Stringfellow, with some account of W. S. Henson* [as an appendix to Aeronautical Classics, No. 5. *Gliding*, by Percy S. Pilcher, 1810]. Illustrations. 8vo. 1810

The aeronautical work (especially in California) of Stringfellow's other partner is related in the typed 'Notes on the Life of Frederick Marriott', by Sir Cyril Kirkpatrick, 1918, in the library of the Royal Aeronautical Society.

WALKER (T.). *A Treatise upon the Art of Flying, by Mechanical Means . . . Likewise Instructions and Plans for making a Flying Car with Wings, &c.* 8vo. pp. i–x and 5–67, folding plate (sometimes coloured). Hull, 1810

—— *A Treatise upon Aerostation: or, The Art of Travelling through the Air by Mechanical means alone.* Second Edition, &c. 8vo. 28 pp., including the frontispiece (sometimes coloured). Bristol, 1831

This Second Edition varies—in omissions, additions, &c.—from the foregoing. The plate also is different. The two editions (which are both very rare) were incorporated in the reprint issued as No. 3 of Aeronautical Classics, 1910. The first edition was reprinted in New York in 1814 and 1816, and again by Means, 1895.

WENHAM (F. H.). Aerial Locomotion [in *Aeronautical Society's First Annual Report*, 1866, pp. 10–40]. Diagrams. 8vo. 1866

Reprinted in Means, 1895, and as No. 2, Aeronautical Classics (with a Biographical Notice), 1910. Wenham also contributed a short paper on 'Suggestions and Experiments for the Construction of Aerial Machines' to the Proceedings of the Second International Conference on Aerial Navigation, Chicago, 1894, p. 297.

KITES

CHANUTE (O.). *Progress in Flying Machines.* New York [1894]

Contains numerous references to various types of Kites, both old and modern, as used for various purposes.

DANSEY (Capt. G. C.). *Kite for effecting a communication between a stranded ship and the shore.* (Transactions of the Society of Arts, vol. 41, p. 182). 1823

One of the many methods proposed during last century to adapt Kites to the purposes of life-saving from shipwrecks.

LECORNU (J.). *Les Cerfs Volants.* Plates. 246 pp. 8vo. 1902

Though in the main an exhaustive technical treatise, there are many references to the use of Kites for scientific and other purposes from the eighteenth century onwards.

[POCOCK (George).] *The Aeropleustic Art, or Navigation in the Air, by the use of Kites, or Buoyant Sails.* Engraved title, 51 pp. 2 coloured aquatints, and a plate of the ' Charvolant '. 4to. [Bristol, 1827]

Originally issued in boards with a label on the side. Rare. A Second Edition (though without reference to the foregoing) was published as :

A Treatise of the Aeropleustic Art . . . With a Description of the Charvolant, or Kite Carriage. Folding plate, and 6 illustrations drawn on stone by Rose Gilbert (A. Pocock, lith., Bristol). 54 pp. Sm. 4to. Picture boards. Longman, 1851

BIBLIOGRAPHIES, &c.

Aéro-Club de France—Catalogue de la Bibliothèque. 63 pp. 8vo. 1922

Aeronautica Illustrata. A Complete Cabinet of Aerial Ascents and Descents, from the Earliest Period. [Collected by G. J. Norman, 1850–60], in 10 vols. Folio. Patent Office [1850–60]

BANKS (Miss). *Collection of Broadsides [and Engravings] relating to Balloons, &c.* [formed by the daughter of Sir Joseph Banks, and now in the British Museum, press mark 1890. e. 15].

Bibliotheca Aeronautica. 2 parts (Catalogues Nos. 387, 170 pp. and 435, 156 pp.). Plates. Messrs. Maggs Bros., 1920–3

BOFFITO (P. G.). *Saggio di Bibliographia Aeronautica Italiana.* Plates. 37 pp. Roy. 8vo. Florence, 1906

BROCKETT (P.). *Bibliography of Aeronautics* [to 1909]. 940 pp. Washington, Smithsonian Institution, 1910

Catalogue of a Collection of Engravings, Drawings, Portraits, Autographs, &c. [formed by John Cuthbert and J. J. Fillinham] *relating to Ballooning and Flying* (as sold at Messrs. Hodgson's Auction Rooms, Mar. 30, 1917). See Appendix IV.

Catalogue of Paintings and Prints of the Earliest and Latest Types of Aircraft, exhibited at the Grosvenor Gallery, arranged by the Countess of Drogheda. 74 pp. Plates. 4to. 1917

Katalog der Historischen Abteilung der Ersten Internationalen Luftschiffahrts-Ausstellung (I L A) zu Frankfurt a. M., 1909, von L. Liebmann und G. Wahl. 513 pp. Illustrations. 4to. Frankfurt a. M., 1912

A valuable work of reference, compiled with notable care and accuracy. Dr. Liebmann has since completed (but not published) a 'general aeronautical bibliography', comprising 3,917 items, as against 1,554 in the foregoing.

MacSweeny (J.). *An Essay on Aerial Navigation.* [List of Aeronautical Books and Magazine articles at p. 83.] Cork, 1844

Patent Office: Subject List of Works on Aerial Navigation, &c. 63 pp. 12mo. 1905

Science Museum, South Kensington—List of Works on Aeronautics in the Science Library. Second Edition. 42 pp. 8vo. H.M. Stationery Office, 1913

Tissandier (G.). *Bibliographie Aéronautique.* 63 pp. Roy. 8vo. Paris, 1887

Wouwermans (A.). *Contribution à la Bibliographie de la Locomotion Aérienne.* Plate. 44 pp. 4to. (Limited to 100 copies.) Anvers, 1894

APPENDIX IV

NOTE ON THE CUTHBERT AERONAUTICAL COLLECTION

THE foregoing chapters, more particularly those dealing with ballooning, having been based to a large extent on the material contained in the Cuthbert Aeronautical Collection, it may be deemed useful to put on record some brief account of its inception and subsequent ownership. The formation of it was apparently commenced some time before 1820 by John Cuthbert, whose identity remains obscure, and of whom it can only be said that he was a ballooning enthusiast, who was living in 1837 at 84 Brook Street, Lambeth.[1] The Collection consists mainly of contemporary engravings and drawings, a great quantity of cuttings and excerpts from newspapers and magazines, and a large number of hand-bills and posters of balloon ascents, together with fragments of notable balloons, there being throughout occasional comments or corrective notes in Cuthbert's handwriting. His enthusiasm led to the acquisition (through Cavallo) of a small fragment of the 'Charlo-Montgolfière' in which Pilâtre lost his life in 1785, and it outran the enormity of an unabashed note to the effect that a diminutive piece of the balloon in which Blanchard and Jeffries crossed the Channel, was 'procured from the Town Hall at Calais by my self'.[2] In general it is clear that Cuthbert took the utmost pains in the formation of his Collection—he would go to the trouble of obtaining galley proofs of contemporary newspaper accounts, and proof pulls of woodcut illustrations. In or before 1837 Cuthbert evidently became an intimate friend of Robert Cocking, the parachutist, for after Cocking's tragic death in 1837 he took a prominent part in raising money for the unfortunate man's widow. Moreover, he shared his hobby in aeronautics with his friend, for Cocking's 'grangerized' copy of Cavallo's *History of Aerostation* not only contains a portrait of J.-A.-C. Charles, endorsed by Cuthbert, 'purchased in Paris, 1825', but also a portrait of Garnerin cut from the border of the plate depicting the first parachute descent made by the latter from Paris in 1797. Both the plate (which was included in the Cuthbert Collection as purchased by the writer in 1921) and the fragmentary portrait (doubtless cut off for the specific purpose of insertion in the copy of Cavallo) are inscribed in Cocking's hand, 'Mons. Garnerin presented to me this

[1] It is possible he was the John Cuthbert, 'Philosophical Instrument-maker, of 113 St. Martin's Lane', who in 1820 was awarded the Silver Medal of the Society of Arts for a 'Hydro-Pneumatic Apparatus'.

[2] In a volume of cuttings in the possession of the Royal Aeronaut. Soc. there is a letter from Cocking acknowledging in most grateful terms the receipt of a similar fragment of Pilâtre de Rozier's balloon, likewise obtained by Cavallo.

print '.[1] Presumably the book and the print were separated after Cocking's death, when part of the latter's Collection passed into the hands of Cuthbert, and part was acquired by Robert Hollond, who accompanied Charles Green on the Weilburg Voyage in 1837.

At a later date Cuthbert's Collection seems to have been acquired and extended by John Fillinham, his friend and fellow enthusiast in aeronautical matters. Fillinham's interests as a collector were of a wider scope, as may be gathered from the collection of cuttings on sundry antiquarian subjects which is now in the British Museum.[2] He also knew Cocking, for his name is written as witness to the parachutist's signature, obtained—in the manner of present-day 'autograph-hunters'—only a few hours before the fatal descent, and attached to a piece of fabric of the parachute given him by Cuthbert. Moreover it is clear that his hobby was known to balloonists of the day, for Edward Spencer wrote to him about one of his ascents with Green in August, 1838, and Gypson, during a flight in 1841, dropped a letter specially written and addressed to Fillinham as an addition to his collection.[3]

In still more recent times the Collection belonged to George Edward Dering, an electrical engineer, who took out several patents for improvements in telegraphy, but whose most practical invention was the 'chair' used in the laying of railways. Broken by the death of his wife, he lived for many years as a recluse at Lockleys, a beautiful Queen Anne mansion in Hertfordshire, setting up in the grounds (much as Sir George Cayley had done at Brompton) a workshop wherein to conduct experiments. He formed a remarkable collection of old and modern books on electricity—the former included a copy of Peregrinus, and the 1600 edition of Gilbert on the Magnet—but when or how he acquired the Cuthbert Aeronautical Collection is not known.[4] While in Dering's possession the Collection remained precariously in the unfinished state in which it was left by both Cuthbert and Fillinham, and on March 30th, 1917 (owing to the death of Dering), it was sold by auction in Chancery Lane for £540.

To bring down to date this remarkable, if not unbroken story of ownership, it may be added that in June, 1919, the writer conceived the idea of acquiring the Collection for presentation to the late Air-Commodore E. M. Maitland, as a gift from his friends commemorative of the historic Atlantic crossing of R 34. But mainly owing to Maitland's disinclination—at once typical of

[1] Cocking's 'grangerised' copy of Cavallo was acquired from the Hollond Sale by the late Air-Commodore E. M. Maitland, by whom (on his hearing the story of the Garnerin print) it was generously presented to the writer in 1921. Thus after a separation of probably over eighty years the print and the portrait, which originally formed part of it, are once again in the same Collection.

[2] Fillinham (J.), Collection of Cuttings, Press-mark 1889 b. 10.

[3] Fillinham was also known to Dupuis-Delcourt, the French aeronaut, as shown from several prints in a collection of aeronautical engravings in the Bibliothèque National, which are inscribed by the latter as 'donne par M. Fillinham, 7 Sep. 1837', &c.

[4] Dering's collection of electrical books was sold *en bloc* in 1913 to a scientific institution in the United States.

his modest bearing and unselfish comradeship—to accept a personal memento even of this crowning achievement of a cause in which at that time he was absorbed heart and soul, the presentation was not made, and the Collection remained in the hands of the writer to serve as a spur, not less than as a most valuable source of information, for the present work. It has moreover led to a final rearrangement (and preservation in mounts) of the whole of the engravings, posters, broadsides, and the rest, and to the binding in quarto volumes of the sheets of news-cuttings and the smaller prints. Thus, if present intentions are fulfilled, this remarkable Collection is in a fair way to be handed down to posterity in a form the lines of which were laid down by the original owner, John Cuthbert, nearly one hundred years ago.

INDEX OF NAMES AND SUBJECTS

The subject headings are arranged in approximate chronological order. A few entries within square brackets [ ] are not otherwise referred to, and the books mentioned in the Bibliography (Appendix III) are not wholly included.

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